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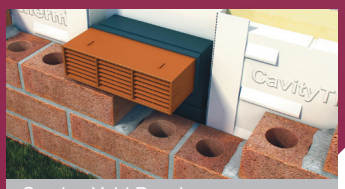
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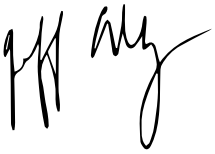
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We hope you enjoy the magazine, share it with colleagues and friends, and refer back to it over time. Passive House Plus is a real labour of love for the team here. We hope you find it beneficial, and that we help in some small way to expedite the transition to robust, healthy, sustainable buildings that Ireland so urgently needs.

Regards,



Jeff Colley
Editor/publisher
Passive House Plus

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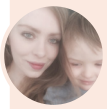
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Disclaimer: The opinions expressed in Passive House Plus are those of the authors and do not necessarily reflect the views of the publishers.

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editor's letter

ISSUE 25

Finding certainty in an increasingly uncertain world can be a tonic, something absolute to cling on to amid the chaos of escalating trade wars, government by tweet, Brexit and its potential implications for peace and prosperity, and extreme weather events that can throw all shapes of unpleasant – even catastrophic – surprises at our societies. So, when we find that elusive thing – the certainty of comfort, resilience and the conditions to protect our health, well-being and bank balance for many decades to come — we should be embracing it wholeheartedly.

Well-designed, evidence-based approaches to low energy building provide a rare example of this. While large swathes of the UK and Ireland were in the jaws of the Beast from the East in March, a stream of snowed-in passive house occupants with time on their hands were on social media, reporting that their homes were performing as normal, gleefully ignorant of the arctic tundra at their doorsteps. It brings to mind the words we so typically hear from passive house occupants when we try to give our readers a sense of what life is like in these buildings: they have to go outside to check what the weather's like.

As the days get longer and the weather – hopefully – improves, this same phenomenon should occur during hot weather too. Of course, that's not to say that even the best-designed low energy buildings won't tend to be warmer in summer than winter. But approaches like passive house, with due care, can help us to avoid some of the shocking stories of overheating that are starting to emerge, such as the monitoring study I recently came across by academics at Southbank University, of a London apartment building which hit temperatures as high a 47.5C – while adjacent rooms with the same aspect but strategically placed external blinds were nearly 20C lower.

Findings like these are too easily dismissed, with the main argument being that London is a special case in terms of overheating risk. And while there's truth in that, this study included some other worrying findings. So while the high point of 47.5C was registered on a September day when the mercury hit 27.9C outside the building — with the two preceding days hitting peaks of over 31C – a later, milder period in the study showed three successive days where outside temperatures didn't exceed 21.5C, but the room temperature peaked at between 42C and 45C each day.

The buildings we design today will likely be put through the ringer by climate change and a future where weirdly divergent weather extremes may cause us to curse our lack of foresight. Paradoxically, climate change offers us the certainty of uncertain, volatile, testing conditions. Yet there are approaches we can take – such as the passive house standard, and even then with at least one eye on how projected climate conditions 30 years or more down the road may affect the building – which can help to protect us from the worst impacts of climate extremes.

Most worryingly, our dilemma may no longer be the question of a distant threat that we ignore as a society while we struggle to change our ways. Forget about threatening our children and grandchildren in later life, climate change is becoming a clear and present danger to the health of our children now – and even to our grandparents. We're reaching a point where climate change mitigation isn't about some notionally selfless do-gooder-ism for an intangible future benefit. It is becoming about our immediate self-interest.

Regards,
The editor

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In the classic story of the three little pigs, the big bad wolf may have blown down the first little piggy's house of straw with consummate ease — but he wasn't reckoning with this pioneering, energy bill-shredding Suffolk project, the UK's first load-bearing straw bale passive house.

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When architect Tony Godwin wandered into a seminar on the passive house standard at Ecobuild ten years ago, it was the start of a journey that would eventually see him design and build his own passive home on a sloping site — and learn some hard lessons along the way to achieving a comfortable, ultra-low energy family home with tiny energy bills.

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Irish regional energy agency offers insights on how to kick-start climate action

One of Ireland's pioneering and most consequential green organisations, Tipperary Energy Agency, turned 20 at the end of February, evolving from one man buried in sawdust to a 24 strong team whose efforts are influencing national policy and earning European plaudits. But why has the agency endured and grown, and what lessons can be learned to help others play their part in delivering the transition we so urgently need to low energy buildings and clean energy generation? Two of the central figures in the agency's development spill the beans, along with some of the many partners the agency has worked with over the years.

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The devil is in the details

The use of properly calculated, well executed thermal bridging details can make it much cheaper and easier to achieve good energy ratings and comply with tightening building regulations. But these benefits can only be realised if buildings are designed and constructed in accordance with the details – which requires great care – argues Simon McGuinness.



Breaking the mould in Thamesmead

The net effect of poor insulation levels, underheating and under-ventilation in buildings poses a major public health threat. Peter Rickaby describes one pioneering London project that's taking a practical, methodical – and scalable – approach to solving the problem.

One day two years ago I visited Thamesmead for the first time. Architecturally, it was an eye-opening experience. Built in the 1960s and 1970s by the GLC, this huge estate in south-east London, if overlaid on central London, would stretch from St Paul's Cathedral to Marble Arch. It is home to thousands of households and has all the iconic features of mid-twentieth century social housing: a line of high-rise tower blocks with views over the Thames estuary; medium-rise deck-access blocks, one of them half a kilometre long; courtyards, alleyways, a ribbon of parkland; and a lake surrounded by housing, which featured evocatively in the original architects' drawings. Thamesmead pre-dates the Thames barrier, so circulation was originally above potential flood level, via raised decks and walkways that are still in use; the ground level accommodated only garages, now colonised by residents' downward extensions. The construction is reinforced concrete with pre-cast concrete panels; a few of the original metal-framed single glazed windows remain.

> Thamesmead was the perfect setting for Stanley Kubrick's 1971 film A Clockwork Orange. Not much has happened there since then.

Thamesmead was the perfect setting for Stanley Kubrick's 1971 film of Anthony Burgess's dystopian novel A Clockwork Orange. Not much has happened there since then. Now Crossrail (the Elizabeth Line) is bringing investment to Thamesmead, land values are rising, old homes are being demolished, new homes are being built. There is an ambitious regeneration plan for the area, and a legacy of problems.

I was invited to Thamesmead that day by Peabody's sustainability manager. Would I like to join a team to develop and deliver a condensation, damp and mould (CDM) strategy for Thamesmead? This request proved to be not only an opportunity to make a positive difference to people's homes, but a big challenge. Subsequent visits to Thamesmead homes revealed the worst condensation and mould I have seen in thirty-five years as a consultant: homes with mould covering walls and ceilings in living rooms and every bedroom; bathrooms that at first looked as though they had been painted black; parents cleaning mould daily with bleach and trying to keep their toddlers away from both; even in summer, mould-stained paintwork everywhere.

How could social housing be in this condition in the UK in the twenty-first century? Peabody recently acquired the estate through a merger with Gallions HA, who had themselves acquired it through stock transfer. Other than new windows there has been almost no investment in Thamesmead for forty years: the most significant change was replacement of the visionary but inefficient and worn-out district heating system with individual gas-fired central heating systems. Before that change most residents were warm and dry, perhaps over-heated; since then many of them have been overtaken by fuel price rises and become fuel-poor, and their poorly insulated, underheated and under-ventilated homes have become cold, damp and mouldy.

For the last two years our team of Peabody staff, surveyors, consultants, contractors, suppliers and installers has walked the length and breadth of Thamesmead several times over. We have made room-by-room CDM and ventilation surveys. We have risk-assessed the stock, classified homes into three levels of mould risk and devised three levels of intervention. We have initiated a programme of energy advice that will eventually reach every household. We have applied mould washes, replaced boilers and undercut doors. We have tested and adopted a smart heating controller that not only reduces resident's fuel costs but also allows us to monitor conditions inside their homes, before and after improvement. We wrote a challenging ventilation specification that only one ventilation supplier could meet, and they have configured their demand controlled mechanical extract ventilation (MEV) system to each of the dwelling types on the estate. We have tried (and failed) to cut holes for ventilation ducts through 190mm thick reinforced concrete floors. We have re-routed ventilation ducts to avoid penetrating panels containing asbestos. We have installed external air inlet grilles at height without scaffolding or ladders. We have used data from smart heating controllers to target homes for improvement, to monitor the effectiveness of interventions, and to brief the energy advisor. We have also rigorously evaluated everything we have done. More subjectively, I recently visited some of the homes that were improved last year, to reassure myself that the mould has not returned this winter.

Naively, I thought at first that Thamesmead's mould problem must be unique, but many other, similar examples in the UK and Ireland have come to my attention. The award-winning Thamesmead CDM strategy has established a model of best practice. It demonstrates the strength of a dedicated, multi-disciplinary team taking an evidenced-based, systematic approach and using new technology to address a wicked problem that has frustrated landlords and householders for decades. I am proud to be part of Peabody's team tackling the CDM problem at Thamesmead, but I am ashamed that there is such a problem to be tackled, in Thamesmead or anywhere else. ■

Dr Peter Rickaby is an independent energy and sustainability consultant working in the building and housing industries. He is a Trustee of the National Energy Foundation, a member of the Each Home Counts Implementation Board, chairs the BSI Retrofit Standards Task Group and is the training lead at the UK Centre for Moisture in Buildings.

Other members of Peabody's Thamesmead CDM team include the contractor Vinci Facilities, the ventilation installer NJS Electrical, the ventilation supplier Aereco, the smart heating controller supplier Switchee, and many members of Peabody's staff including sustainability officers, surveyors, contract managers and a heroic energy advisor.



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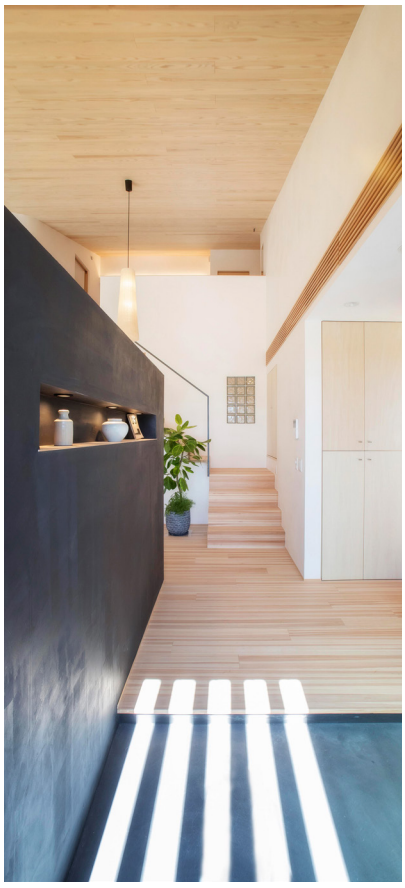
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Photos: Key Architects





MASAKI PASSIVE HOUSE, SHIKOKU, JAPAN

Key Architects are rapidly gaining a reputation as Japan's leading passive house design firm, and first came to the attention of Passive House Plus with their stunning Tochoji Temple in Tokyo, which we featured in issue 22.

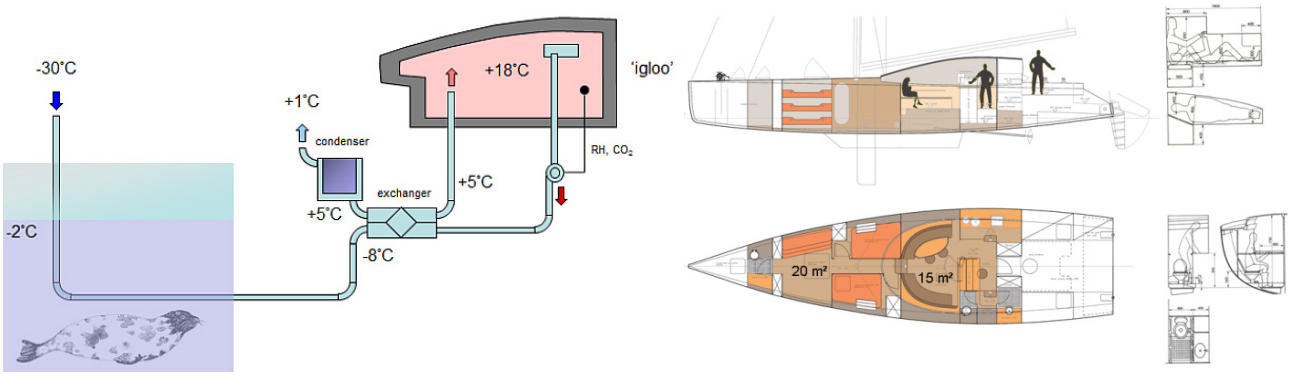
Their latest passive house project is a contemporary dwelling in Ehime prefecture on Japan's rural Shikoku Island, boasting a wide-open southerly orientation and stunning views over the adjacent farmland towards the wooded peaks beyond.

And wood is at the heart of this striking contemporary dwelling: the plywood-framed walls are insulated with wood-fibre, and timber cladding also features heavily. Meanwhile the windows are made of aluminium-clad timber, and the house's main source of space heating is a stove that burns wood logs.

Because Shikoku's climate is warm and temperate, with daytime temperatures averaging 27.5C in August, the house didn't need as much insulation as a typical passive house in northern Europe — U-values for the walls range between 0.18 and 0.21, for example (less than 0.15 is the norm for the UK and Ireland).

The thick clay that forms the external leaf of the walls also helps to buffer moisture in the humid local climate, while providing airtightness without the need for membranes. And a solar thermal array located beside the vegetable garden also helps to provide for space heating and hot water.

Considering all of that, it's no surprise the house won Japan's third annual Eco House Design Award in 2017.





Photos: Peter Gallinelli

THE NANUQ, PASSIVE HOUSE BOAT

Designed, built and skippered by Swiss architect Peter Gallinelli, the Nanuq is a 60 foot sailboat intended to serve both as a scientific base and accommodate a team of six through an arctic winter.

And with the arctic climate in mind, the cabin that sits at the heart of the boat is designed according to passive house principles — Gallinelli calls it his 'passive igloo'.

Gallinelli's aim was to design a boat that would allow him to comfortably "pass through an arctic winter in a self-sufficient dwelling without the use of non-renewable energy".

The project was inspired by Norwegian explorer Fridthof Nansen's legendary 19th century boat Fram, which — with its oak frame, cork insulation and triple glazed windows — is often regarded as an early example of passive design.

The igloo at the core of the Nanuq is constructed from a frame of fibreglass and epoxy resin skins sandwiching a core of high performance polystyrene insulation, giving the cabin walls a passive-level U-value of 0.12.

Triple glazed windows feature too, while the completed 'igloo' weighs only 1,300kg and can be dismantled into five easily transportable parts.

And just like a passive house, the boat also features a heat recovery ventilation system, albeit an experimental version tailored for the particular stresses of the arctic conditions. Incoming fresh air from outside — which is often colder than -30C in winter — is first preheated by the relatively balmy seawater (at about -2C) in a submerged tube, before entering a marine grade heat exchanger. Care was required to prevent the heat exchanger icing up, with water from condensation being directed into a bottle, while the air outlet also had to be adapted to prevent blocking by the formation of ice.

A 1.5 kW wind turbine combined with four solar PV panels – which contributed nothing between the sun setting for winter in October and rising in February – power the boat, with a back-up diesel generator, and every effort was taken to reduce electricity use to a minimum of just 0.5 kWh per day – for a boat serving 2.5 occupants.

In order to test the performance of the passive igloo, the boat was voluntarily trapped in sea-ice in north-west Greenland during the winter of 2015-2016 and monitored during 10 months of 'stationary navigation'.

According to Gallinelli, the biggest unforeseen difficulty was the unexpected lack of wind during the arctic winter, which meant the boat had to rely on a back-up forced air diesel heater for heat rather than wind-powered direct electric heating. Gallinelli notes that a heat pump, which was omitted for budgetary reasons, would have provided 100% of thermal comfort needs during a more typical arctic winter.

Still, the boat used just 330 litres of diesel over the winter — ten times less than average homes in the region.

Powered passively by the wind, the Nanuq will venture northward again this summer as part of PolarQuest 2018, a scientific mission to measure the impact of human pollution in arctic waters, assess the impact of micro and nano plastics in the region, and study the origin of high energy cosmic rays and their impact on global warming.



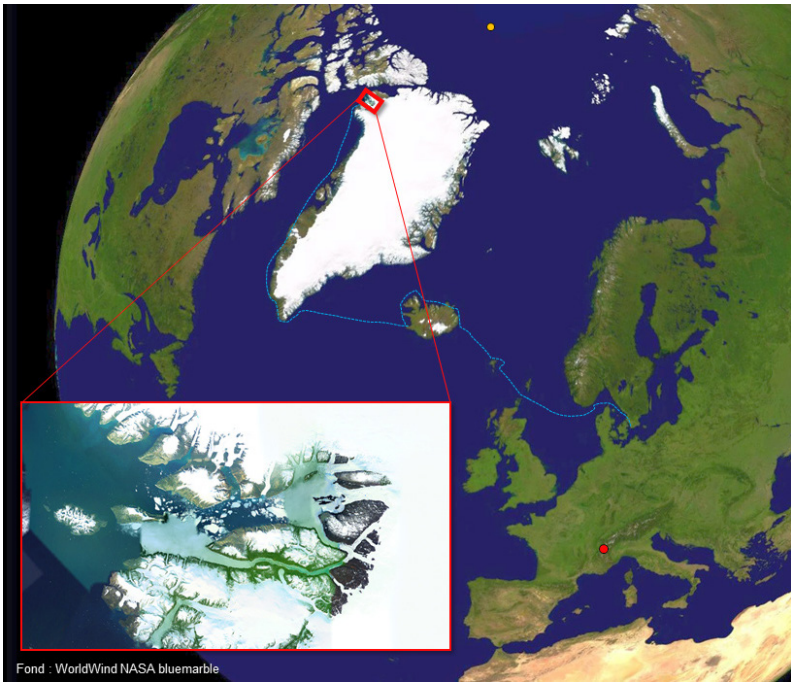
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NEWS

Green finance must be long-term & sustainable — Ecology



Ecology Building Society chief executive Paul Ellis

Leading green lender Ecology Building Society has welcomed the publication of the Green Finance Taskforce's report to the UK government on boosting green finance, but warned that any measures to stimulate green lending must be long-term and sustainable.

Published in March, the 'Accelerating Green Finance' report makes a number of recommendations for boosting financing for sustainable building projects, including the introduction of short-term incentives to 'pump-prime' the green lending market.

Responding to this, Ecology Building Society chief executive Paul Ellis said: "While it's positive to see that recommendations to develop the green mortgage market take centre stage in the taskforce's report, it is important that any approach taken to 'pump-prime' green lending offers more than merely a short term subsidy that fails to create a long-term, sustainable solution and, we learn from previous initiatives such as the Green Deal."

The report also recommends that all UK lenders "work towards promoting awareness and mainstreaming a consideration of green factors into all their mortgage lending decisions." It says that mortgage lenders should include energy performance certificate (EPC) ratings on mortgage statements to raise awareness of their importance.

Responding to this, Ellis said: "We also question the additional benefit of green tagging lenders' loan books if, in practice, it does not extend beyond referencing EPCs given that, as the taskforce has acknowledged, we already have a well-established EPC register in the UK.

"All our lending already takes green factors into account so we welcome the proposals to increase the visibility of EPCs during the mortgage process."

With regard to buildings, the report also recommends the introduction of EPC targets for commercial buildings, as well as operational energy ratings for all buildings, as well as calling for research into fiscal measures to boost the popularity of energy efficient retrofits. It also calls for the establishment of a green finance institute and green financial technology hub in the City of London.

Ecology Building Society welcomed the focus on green financing, with Paul Ellis stating: "If we are to meet our Paris climate change commitments, finance needs to support the transition to a low-carbon economy. Housing and the built environment makes up more than a quarter of our carbon emissions so we urgently need measures that deliver energy-efficiency improvements – whether that's retrofitting our existing housing stock or building zero carbon homes."

"We've been providing sustainable mortgages for more than thirty years, offering innovative discounts that incentivise the most energy efficient projects and properties."

He continued: "It's encouraging to see fiscal measures such as stamp duty reform being actively considered which would help spur homeowners to take action." ■

Planning granted for major passive scheme in South Wales



An innovative scheme to develop the site of the former Caerphilly Magistrates Court in South Wales into 38 new social homes built to passive house standard has been granted planning permission by Caerphilly Council.

Childs & Sulzmann Architects were initially approached by affordable housing provider, Linc-Cymru, to explore options for applying passive house energy efficiency standards to a proposed social housing development. Then, as architects and lead consultants for the £5m scheme, Childs & Sulzmann worked collaboratively on the planning process and produced the tender pack for the scheme.

The news of the planning approval for the first large-scale passive house project in Wales came on the same day that tenders were received from contractors bidding to build the scheme. The project was due to start on site in April 2018 with an anticipated completion date of January 2019.

Matt Parsons, who heads up the Welsh office of Childs & Sulzmann, is leading the project and commented: "This is an exciting project that will really fulfil a need in Wales for low energy affordable housing. It's a way of ensuring that those who can least afford to pay high energy bills are living in comfortable, warm, quality homes."

Keri Harding-Jones, project manager for Linc-Cymru added: "This project will provide affordable homes for our residents in a sustainable location. The energy saving and improved internal air quality measures provided by [passive house will] help reduce fuel poverty and improve tenant health by eliminating damp and mould. We are delighted that the scheme received planning and can move forward to a site start."

Childs & Sulzmann also supported Linc-Cymru's successful bid to the Welsh government for grant aid for the project, through the Innovative Housing Programme. The funding has been allocated to demonstrator projects to help inform the Welsh government, housing associations and local authorities about the type of homes needed to meet future demand while addressing environmental issues. ■

Top doctor calls for building industry to research indoor air quality

Words by Kate de Selincourt





One of the UK's top doctors has called on the construction industry to collaborate with the medical profession in a research project aimed at making indoor air safer for children. Speaking at the Healthy Buildings Conference & Expo 2018 in February, Professor Stephen Holgate, special advisor on air quality to the Royal College of Physicians, shared his dismay at the lack of knowledge about indoor air and health.

He told the event, organised by the Alliance for Sustainable Building Products, that in 2016 he and colleagues produced a major report on the health impacts of outdoor air pollution, titled 'Every Breath We Take', but that the researchers "could not do justice to indoor air quality issues".

He explained: "There is a real paucity of information. At the moment we don't know what or how much people are exposed to indoors, we lack the recorded data. We really tried to find out – it's awful that we couldn't."

In order to tackle the lack of information and guidance on the topic, the Royal College of Physicians, and the Royal College of Paediatrics and Child Health have established an enquiry into how the indoor air quality experienced during childhood affects health across one's lifespan.

Professor Holgate explained that the focus of the enquiry is on children because they are the most vulnerable, and the damage from air pollution can potentially affect them for the rest of their lives.

The enquiry would aim to establish what the risks are and how to mitigate them, and raise awareness to drive policy change. The ambition of the enquiry is to influence the renovation of current housing stock, and the planning and building of new homes, to make indoor air safer for babies and young children.

Professor Holgate extended an invitation to anyone with research evidence relevant to the links between indoor air quality and health – or evidence of steps that could be taken to improve indoor air quality – to work with the team.

The enquiry would benefit hugely from more links with the construction sector he said. "I don't know people in construction, but we really need their help. We need a lot more interest and engagement from industry."

The more manufacturers and other interested groups contributed, the more credible the outcome would be, he added. The project is still short of approximately £50,000 of funding, which would make it possible to proceed with field research to strengthen the evidence base (a document outlining the proposal is available at **tinyurl.com/iaqresearch**).

Professor Holgate also highlighted the risks to respiratory, cardiovascular and neurological health posed by PM2.5 particulate pollution, which can enter buildings through outdoor air, and which are also added to the indoor environment by cooking and the burning of wood and coal in stoves and fireplaces, and by candles and indoor smoking.

Many speakers at the February ASBP event were also concerned by the rapid rise in new chemical entities in our day-to-day environments , and how they might affect our health and mental functioning.

Consultant clinical psychologist at UCL, Dr Sarah Mackenzie Ross, told the meeting that many thousands of substances are in commercial use which have the potential to damage our nervous systems.

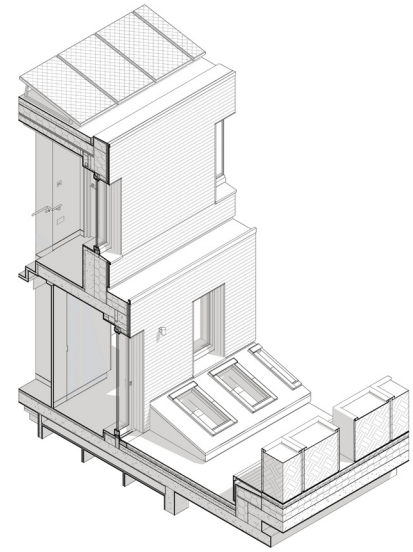
"There are around 100,000 potentially neurotoxic substances in commercial use, with 2,300 new ones every year. There is no way for research into their impacts to keep up," she said.

For example, she said, organophosphate compounds are present in many household products and materials: they are used as an insecticide, and as a flame retardant in synthetic foams, among other applications, yet they are known neurotoxins.

She also told Passive House Plus that even "day-to-day" domestic exposure to carbon monoxide, such as from faulty boilers, can lead to neurological symptoms such as seizures – as well as other medical issues such as respiratory difficulties, headache and flu-like symptoms bad enough to lead to hospitalisation. ■

(above) Prof Stephen Holgate, special advisor on air quality to the Royal College of Physicians, pictured at the ASBP's Healthy Buildings Conference & Expo 2018 in London; delegates at the event.

Visit passive house projects in London this summer



Leading passive house builders Bow Tie Construction will host a series of talks and tours of their latest passive house and Enerphit projects this year in collaboration with the Green Register. Four site visits are planned between May and September, and are scheduled to occur during the most interesting stages of construction.

The planned site visits are:

- 17 May, Lawford Road Enerphit: a four-bedroom semi-detached house that is being completed to Enerphit standard, with an independent timber frame being constructed within the existing property.
- 21 June, Camden Mews passive house: a new build two-bedroom passive house being constructed in the rear garden of an existing property. At the time of this site visit, the project is due to be undergoing first fix and installation of the MVHR system. The Bow Tie team will be on site along with the project designers, Bere: Architects, for this special four-hour workshop.
- 12 July, Onslow Gardens: an Enerphit upgrade, plus ground-floor rear extension, to a four-bedroom four-storey house with an unusual layout. The house is undergoing a total internal refurbishment and reconfiguration.
- 13 September, Camden Mews passive house: This is a return visit to the site mentioned above, when the project will be completed or near completion.

For more information and to register for these events, see **www.greenregister.co.uk** ■

(above) An extract of Bere: Architects' detailed 3D BIM model of the Camden Mews scheme.

World's first passive house hospital under construction



(above) An illustration of Frankfurt Höchst Hospital, the world's first hospital designed to the passive house standard, which is currently on site.

The world's first hospital designed to the passive house standard is currently under construction in the Frankfurt district of Höchst. The building's shell is complete and interior works are expected to be complete by the end of the year. This will be followed by a test phase of several months before the hospital goes into full operation.

The Passive House Institute in Darmstadt has been advising on the project since the design phase. Designed by Wörner Traxler Richter Architects and being built by BAM Deutschland AG, the hospital is the biggest construction project currently on site in Frankfurt, and once completed, the finished building will boast 664 beds and ten operating theatres.

In a baseline study carried out prior to design, Oliver Kah of the Passive House Institute and his colleagues examined how the passive house concept could be applied to hospital design. Unsurprisingly, one of the key findings was that hospital equipment has a major influence on energy demand, and that generally speaking, hospitals consume three to four times more energy than residential buildings of the same size.

"In addition to providing improved comfort, the passive house standard is designed to reduce the energy demand considerably, therefore this energy efficient concept is particularly valuable for hospitals," says Kah.

Kah explains that conventional energy modelling and verification tools typically only take account of the energy demand for conventional energy loads like heating and cooling, ventilation, hot water, and lighting — making them less useful in the design of hospitals. MRI devices alone can account 7% of a hospital's energy use, for example.

"The distribution of energy shows that hospitals are usually equipped with more devices and have energy-intensive processes," says Kah. "If the energy demand is calculated using conventional methods, almost half of the future energy demand remains unconsidered."

At the hospital in Höchst, the passive house standard will help to ensure a constant, comfortable temperature of 22C is delivered to patient rooms with far less energy than in a conventional hospital, as well as ensuring the delivery of high-quality healthy pre-heated air through the mechanical ventilation with heat recovery (MVHR) system. ■

UKGBC: councils & developers must work together to boost housing quality



UKGBC's new housing standards playbook and guidance for developers on social values in new housing were launched at a packed UKGBC event in Bristol.

New air-testing standard launched for passive buildings

The Passivhaus Trust and Attma, the Airtightness Testing & Measurement Association, have jointly announced the launch of a new airtightness testing standard for passive and low energy buildings.

The new TSL4 standard, which has been in development for more than six months, will encompass both domestic and non-domestic buildings.

Existing air testers will be able to train to become registered passive house testers via Attma's accredited training courses.

The new standard includes guidance on testing methodology, building measurement, preparation checklists, and accredited training courses.

Kym Mead, associated director of the Passivhaus Trust, said the aim of the standard is to remove any confusion when air-testing passive and low energy buildings, and to provide air testers with additional training in the passive house standard.

Barry Cope of Attma added: "As with all of our guidance, the aim is to make the standard as clear as possible, removing ambiguity and commonly assumed errors, so that the very low leakage testing community can operate uniformly with an agreed reference point."

The new standard can be downloaded from **www.attma.org**. ■

The UK Green Building Council (UKGBC) has launched two new resources for developers and local authorities designed to help boost housing standards and improve social value. The first resource takes the form of a housing standards playbook, designed to support local authorities to drive up the sustainability of new homes through policy.

UKGBC's housing standards playbook urges local authorities to act consistently to set a standard for all new homes to target a 19% carbon emissions reduction compared to building regulations, and commit to a policy for all new homes to be net zero carbon in operation from 2030 at the latest. Meanwhile, the playbook urges local authorities to require developers to demonstrate they have acted to mitigate against overheating risk, and have acted to close the performance gap. The playbook includes a section on the passive house standard, noting that the standard has been posited by the Passivhaus Trust as meeting or exceeding the playbook's targets. The report also recommends the use of the passive house software, PHPP, or the BRE's Home Quality Mark, as a tool to enable early assessment of overheating risk in the design of new homes.

The second resource, Social Value in New Development, is guidance for developers and local authorities to help deliver social value outcomes in new residential and commercial developments.

The guidance looks at social value, its stakeholders, strategies for driving positive outcomes and measuring success, and the current barriers to delivery. It provides a detailed overview of the outcomes and opportunities the consideration of social value in development can provide across three key areas: jobs and economic growth; health, wellbeing and the environment; and strength of community.

The resources were launched at a packed UKGBC event in Bristol, which brought together local authorities, developers and other industry stakeholders to discuss how to deliver better outcomes.

Julie Hirigoyen, chief executive at UKGBC said: "Raising the bar on standards for new homes and tackling energy and climate change are fundamental to delivering the high-quality, efficient, and healthy new homes we need."

Hirigoyen added that the benefits of sustainability would extend beyond the occupants of housing to wider communities and cities at large by boosting local economies and quality of life, by providing jobs and apprenticeships, upgrading social and community facilities, while driving health and wellbeing through the provision of nature and green space.

"We hope that these resources can help drive further collaboration between local authorities and developers to deliver truly sustainable development," said Hirigoyen. ■



The House of Tomorrow, 1933

In his third column on visionary eco-buildings of the 20th century, Dr Marc Ó Riain looks at the pioneering passive solar designs of Fred Keck.

If Maria Telkes and Eleanor Raymond were the modern mothers of active solar in the 1940s, then the Keck Brothers were surely the undisputed patriarchs of passive solar in the 1930s.

Whilst contemporary predecessors like Franks Lloyd Wright's prairie-style Robie house (1909) may have featured overhangs and Mies van Der Rohe's Villa Tugendhat (1930) featured optimal orientation, passive solar gain and thermal mass, they did not conform with the key principles of solar design.

Fred and William Keck developed a series of experimental houses starting with the 1933 Chicago World's Fair. The Kecks may have stumbled on the potential of solar gain with their 'Dymaxion' like octagonal house (figure 1). The building, which opened in June in Chicago was described by William Keck as "hotter than hell", as the air conditioning struggled to deal with the solar gain. This is potentially a seminal moment as Fred Keck began to understand the potential of solar gain to deliver winter heat but also realised the need to control it to avoid overheating in summer.

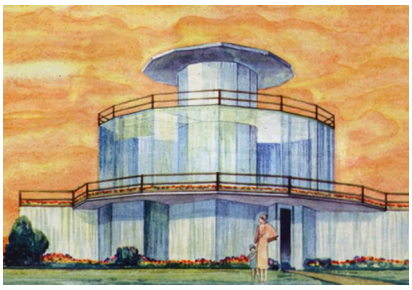


Figure 1: Keck's illustration of the House of Tomorrow

In subsequent house designs Fred Keck became focused on the passive control of heat in his house designs. He experimented unsuccessfully with retractable external blinds (like Koolshade) on the Bruning House (1935) and Fricker House (1938) but abandoned this idea due to issues with manufacture, supply and wear. Perhaps inspired by the Robie House, which was down the road from his own, Keck calculated optimal angles for eave overhangs in 1937 for the Cahn House (Denzer, 2013). This sketch would become a key convention for architecture students across the world. The Cahn House had a 49-degree shading angle providing more solar protection than the 1909 Robie House (66 degrees).

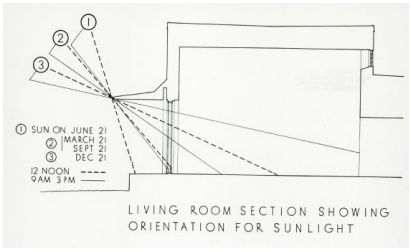


Figure 2: Keck's orientation for sunlight section (1937)

After 1933 Fred Keck would never again use as much glass, perhaps acknowledging the issues of solar gain and heat loss through the glazing. Double glazing was in its infancy, struggling with engineering issues like the retaining seal between the panes, primarily due to material expansion. The Kecks would become one of the first adopters of Liberty Owens & Ford's 'Thermoplane' (sealed double glazing) in the late 1930s. As an architectural engineer, Fred also pioneered water ponds on flat roofs to offset the conductive heat gain through the opaque fabric.

> The house was described by William Keck as "hotter than hell", as the air conditioning struggled to deal with the solar gain.

Keck's principles of orientation, shading, plan, double glazing, active ventilation and rooftop pools come together between the seminal design of Sloan House and a $5,000 variation designed for Coronet magazine in 1940. Keck described the house in layman's language:

"Note the wide eave line; its extent is calculated to shut out the hot summer sun and admit the warm winter sun, and also to protect the house from showers, when the windows are open, making it unnecessary to get up at night to close the windows during a rainstorm. On the coldest winter's day, when the sun is shining, enough of the sun's heat will enter the house to heat it comfortably, giving the interior and the atmosphere of a spring day. The exterior of the house is of wood and stone and glass, and has a 3-level flat roof made to carry a thin layer of water" (Coronet, 1940)."

Keck's description of the house does not refer to energy at all, preferring to focus on the usability of the spatial design and its climatic suitability. Indeed, he offered that the building is so suited to contemporary living the mother-in-law can sleep in the porch…impressive!

Fred Keck strove to find manufacturing collaborators to measure the post-occupancy performance of his buildings, but without success. Whilst he pioneered innovative solutions to deliver thermally comfortable housing, his more well-known contemporaries were taking less sympathetic approaches.

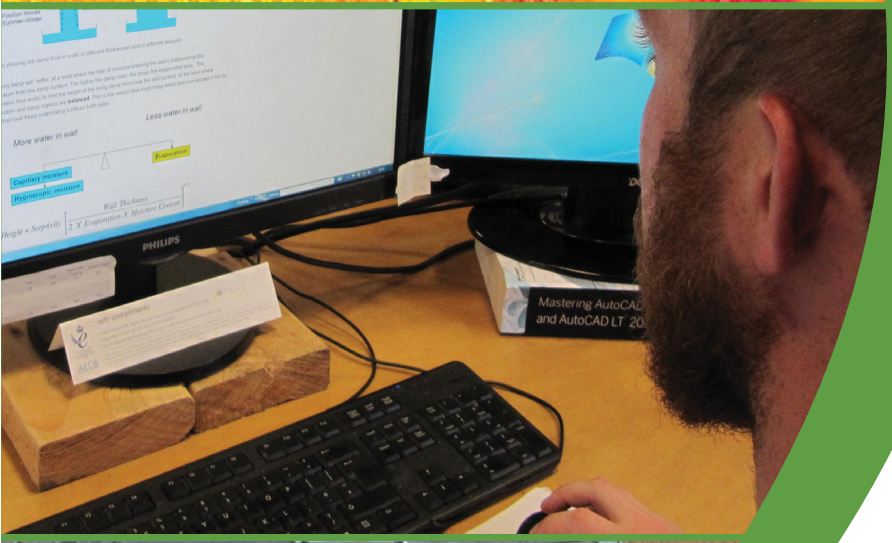
Seminal architects of the international movement, like Mies and Johnson, were designing dysfunctional glass follies, so utterly uninhabitable, that they perhaps represent a visual polemic to the idea that form follows function. To many Farnsworth and the Glass House were the zenith of an aesthetic language, and architecture schools have venerated these models as the paradigms of practice. Unfortunately, this paradigm of architectural practice has held sway for 70-80 years, and the singular focus on form and composition over performance and function has cost society, the environment and the public as a whole.

Perhaps there are still lessons and starting points to be learned from the Kecks' innovative work that truly demonstrates a nexus between architecture and engineering. Continuing to explore the empiricist work of the solar pioneers, we will look at the work of Frank Lloyd Wright's Solar Hemicycle and Usonian Homes in the next issue. ■

Dr Marc Ó Riain is the president emeritus of the Institute of Designers in Ireland, a founding editor of Iterations design research journal and practice review, a former director of Irish Design 2015, a board member of the new Design Enterprise Skillsnet and has completed a PhD in low energy building retrofit, realising Ireland's first commercial NZEB retrofit in 2013.



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£115 Profit

Energy bill: all heating & electricity (including solar feed-in tariff)

Building type: Two-storey load-bearing straw bale house

Location: Onehouse, Suffolk

Completed: September 2015

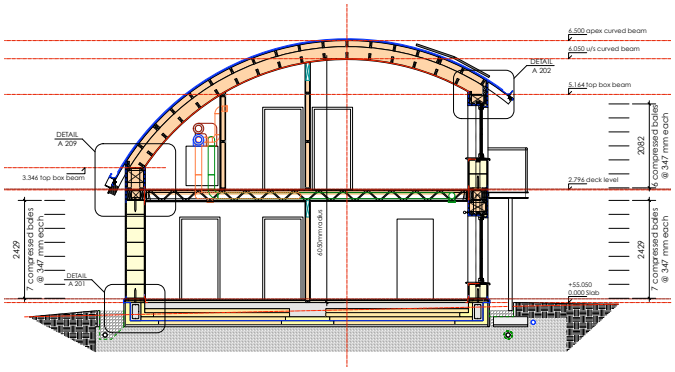
Standard: Passive house classic certified

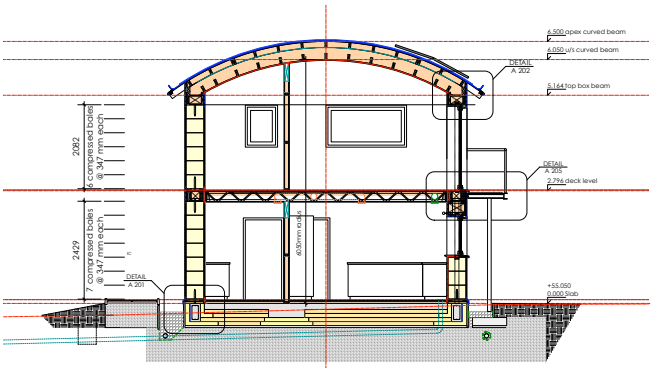
ALL BALES, NO BILLS

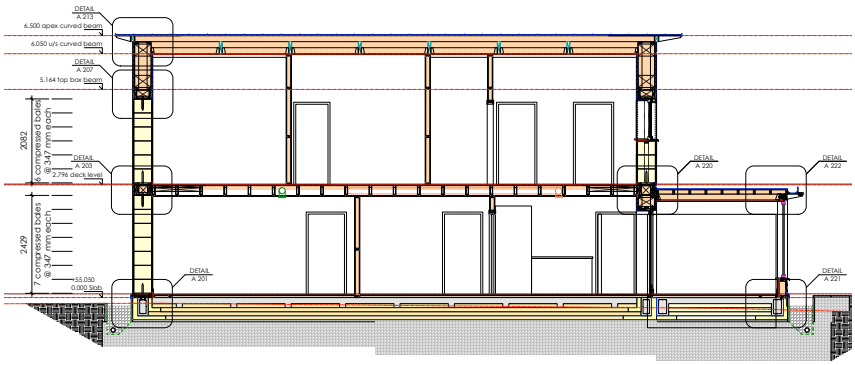
In the classic story of the three little pigs, the big bad wolf may have blown down the first little piggy's house of straw with consummate ease — but he wasn't reckoning with this pioneering, energy bill-shredding Suffolk project, the UK's first load-bearing straw bale passive house.

Words by David W Smith









> At that point, I had to become a super apprentice of everything: carpentry, plumbing and electrics.

Dave Howorth puts his decision to self-build the UK's first load-bearing straw bale passive house down to "a moment of madness". His original intentions had been less ambitious: he had just wanted to satisfy his green instincts by adding a few photovoltaic panels to his old house in Hitchin, Hertfordshire.

But he ended up in a challenging self-build project that required him to learn straw bale construction, defeat planning objectors, and then acquire the skills of a carpenter, an electrician and a plumber on the job.

Meanwhile, the structural engineer faced challenges of his own, partly because of the lack of information available about passive houses, but mainly because the curved roof presented technical difficulties.

So when Dave and his wife Mabel eventually moved into Haven Cottage, in the Suffolk village of Onehouse, in June 2015, it was the culmination of a dream that had taken six years to fulfil. Howorth first became interested in straw bale building back in 2009 when he took a course with the UK's leading expert, Barbara Jones, in Lincolnshire, and visited several straw bale buildings around the UK.

The couple then spent three years hunting for a suitable site before finding the Suffolk





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plot in 2012. Even then, it was not a straightforward matter to go ahead and build the house they wanted. Planning permission was opposed by the parish council, and it took a further three years to design and self-build the house.

Despite the long gestation, Howorth says it was worth it. The house has achieved passive house certification, and is quiet and warm within, he says. The couple appreciate the natural feel and low heating bills. "I love the simplicity and economy of straw bale building and the DIY element of the build. I'd do it all over again," he says.

Howorth's interest in straw bale building was sparked when he read about the ideas of Barbara Jones, whose Straw Works consultancy offers practical courses in straw bale building. Groups of volunteers turn up at a self-build site and help the owner install the bales while Jones, or another qualified tutor, supervises the work.

Equipped with their new skills, the volunteers then go off to carry out their own self-builds. Having attended one of the Barbara Jones courses in 2009, Howorth became part of the straw bale building community and knew he would be able to call on volunteers to help construct his house when the moment came.

The couple bought their plot with planning permission attached in March 2012, but the existing architectural plans were unsuitable. So they asked Andrew Goodman of Hertfordshire-based Good Architecture to provide a new design for a four-bed passive house using 450mm thick compacted bales.

"The site had permission for an unimaginative chalet bungalow, but it wouldn't have achieved the passive house standard and didn't lend itself to straw bale construction," says Goodman. "We created a completely different two-storey design with a curved 'Dutch Barn' style roof in keeping with the Suffolk vernacular."

Architectural assistant Abbie Davies did a lot of the initial design work while studying sustainable architecture at the Centre for Alternative Technology in Wales. Davies argued that the straw bales could be used

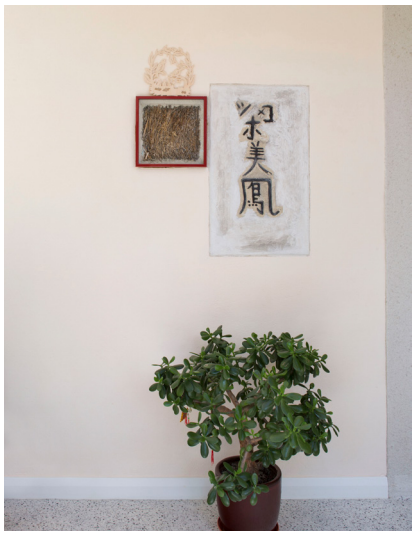
> I love the simplicity and economy of straw bale building and the DIY element of the build. I'd do it all over again.

Photography: Agnese Sanvito

CONSTRUCTION IN PROGRESS



1 Installation of mineral wool full-fill cavity insulation to the insulated box beam; **2** the KORE passive reinforced concrete raft foundation; **3** the walls consist of 450mm loadbearing straw bale; **4** erection of the straw bale ground floor walls under way; **5** hazel stakes were hammered into the straw bales to secure them in place, and a timber box beam was laid on top of the ground floor wall before installation of the first floor; **6**, **7** & **8** a curved 'Dutch Barn' style roof was chosen, in keeping with the Suffolk vernacular, though this design proved a structural engineering challenge because of the forces exerted onto the straw bale walls; **9** a horizontal beam supports the curved roof structure and internal walls were finished with a 25mm lime plaster.



for conventional load-bearing (see 'How the straw bale walls were built').

"We designed it so all the external walls and roof could be built, then plastered on the inside," says Goodman. "We could then do an initial air test before the internal partitions were constructed. That way we could see if there were any holes in the walls and repair them. But as it turns out there weren't any."

The uniqueness of the project provided technical challenges for superstructure engineer Paul Rose, who was brought in because he had previously worked on three straw bale load-bearing houses. At the time, he wasn't even aware that Dave and Mabel wanted to achieve the passive house standard.

"One of the biggest issues with straw bale is the lack of information available," Rose says. "But we've done a few now and learned on the job. A bigger challenge with this project was the curved roof. We had to make sure the lateral forces at eaves level weren't so great that they pushed the straw bales over.

"The roof had to be stiff enough so the arched members didn't push sideways to any great degree and push the walls over. I've only designed two or three roofs like that in my career," he says, adding that "the fact it was straw bale made it tricky and interesting". One of Rose's solutions involved adding a horizontal beam to support the curved beams that create the roof.

The initial conceptual designs were completed in November 2012 and submitted for planning permission, which was opposed by Onehouse Parish Council,

who argued because the home was next to a Grade-II listed cottage, its contemporary design was "totally out of keeping with the character and the appearance of the area". Fortunately for Dave and Mabel, Mid-Suffolk's conservation officer said it would not have any significant harmful impact, and planning permission was granted.

The architects were then able to get to work on more detailed designs, which were completed in stages between August 2013 and January 2014. "Although the design is quite contemporary, finishing straw bale in lime render is ideal in relation to nearby listed buildings," says Goodman. "We haven't used straw in the roof, but we have in the walls. We drew elevations in nice straight lines with plumb corners, but it's all fairly wobbly [looking] because it follows where the bales go. So whilst the design is quite contemporary in some respects, it's softened by the straw bale element."

Irish company Tanner Structural Designs took care of engineering the foundations, using the Irish-made Kore passive slab insulated foundation with external ring beam and internal ribs. Builders laid the foundations, and built the garage, in late 2013. "Hilliard Tanner worked out a way of creating a base plate on top of the concrete ring beam that the straw bale builds off. It's a good solution in terms of transferring loads down into the foundations," says Goodman.

Finally, at the end of March 2014, volunteers arrived at Dave and Mabel's plot of land for another Barbara Jones course and work began to construct the straw bale walls. Dave took a year's sabbatical to work full-time on the project. Volunteers came from far and wide, including France and Sweden. The tutor was Jakub Wihan, who teaches straw bale construction for Straw Works from his base in Todmorden, West Yorkshire.

"The course lasted two weeks and we built the ground floor walls. After a gap of a few weeks Barbara Jones sent more people to help out and we got most of the first floor built. But after a month all the volunteers went home and I was the project manager," Howorth says.

"At that point, I had to become a super apprentice of everything: carpentry, plumbing and electrics. I did have little bits of knowledge from working in a repair shop at school and doing woodwork at school and bits of DIY. But this was on another level."

Airtightness tests revealed a final figure of 0.42 air changes per hour, well inside the passive house standard of 0.6. However, initial tests had been even more impressive. "The initial figure was 0.29 but something happened before the building was finished. When it was depressurised the readings were fine, but when it was pressurised to get an average of the two figures, there was a leak allowing air to escape inside to out, but it wasn't pulling it in from outside to in. But it was impossible to locate it," says Goodman.

The house has no central heating system, as such. Space heating is all provided directly





How the straw bale walls were built

Here's how Dave Howorth and his team constructed the straw bale walls at Haven Cottage. First, the full ground floor walls were built by stacking straw bales onto timber stakes, and then a U-shaped timber beam was laid on top of the wall. Next, fencing wire was wrapped vertically around the walls at intervals of every two to three metres and mechanically tightened.

Several restraint straps were then attached at the top and bottom of the wall on one section (about five strap positions were used in total) and tightened as hard as possible, compressing the bales. Then the straps were taken and moved to the next part of the wall, and the whole process repeated. After going the whole way round the ground floor wall and checking everything was still tight, the wall was declared 'compressed', the U-shaped beam was completed (turning it into a box beam) and work could begin on the first floor using the same process.

Eventually, just before rendering began, the fencing wires were cut out, having served their purpose. The straw was fully compressed and would not rebound. Alternative methods of compression are sometimes used, such as placing tonne bags of sand on top of the wall, or using car jacks to force the tops of the bales down. "Fencing wire seemed like the easiest technique in our situation," says Howorth. "The compression ensures that there are no gaps in the wall or within the straw, thus ensuring both structural and thermal effectiveness."



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CONSTRUCTION IN PROGRESS



1 Plywood boxes ensure accurate positioning of the windows; **2** the windows being fitted into place; **3** the window sitting within the insulating straw-bale layer; **4** airtightness detailing around window junctions minimises drafts and improves acoustic performance; **5** the windows are Livingwood tilt & turn triple glazed alu-clad redwood units; **6** the design had to respect the context, which included neighbouring thatched cottages.

by electrical heaters. There is a post-heater in the ventilation system, which heats up incoming fresh air, plus three radiant heaters fixed to walls inside the house (two in bathrooms, one in the downstairs hall). The basic heating strategy in winter is to use the post-heater, and the radiant heater in the hall, to bring the temperature up to 21C overnight — this is enough to ensure it then doesn't drop below 20C during the day.

Domestic hot water is stored in a Gledhill thermal store, which is basically a big, highly insulated bucket containing 250 litres of water. The water in the bucket is heated by two immersion heaters.

The bottom immersion – at the base of the tank – is connected to a solar diverter that takes spare power from the huge 27 square metre solar PV system whenever it is available. This is the main method of heating water. "It's the only method we use during summer and is used part of the time in winter. The immersion's thermostat is set to 95C to capture as much solar energy as possible and store it as hot water," Howorth says.

Meanwhile, the top immersion – half-way up the tank – is connected to a time switch and its thermostat is set to 60C. This immersion is used as a backup to the solar power, which is why its thermostat is set lower. During winter the time-switch is set to come on for two hours during the night to provide enough hot water for the following day. If required, the immersion can also be switched on at any time for an hour by pressing the boost button on the time-switch.

At the beginning of March 2018, vicious snowstorms swept across the UK and Ireland from the east. When Passive House Plus contacted Dave Howorth to ask how the house was performing at the time, he simply said that it "just behaves as it is supposed to" — and that the temperature inside was just over 20C.

He said that, in general, it was difficult to describe how the house performs. There's not really much to say. He elaborated: "That is, [the] passive house windows keep the drafts and noise out. Passive house walls and windows, and roof and floor, keep the temperature stable so we just sit and look at it snowing outside.

"In summer we sit and look at the sun on the fields."

SELECTED PROJECT DETAILS

Clients: Dave & Mabel Howorth
Architect: Good Architecture
Structural engineer: Rose Consulting Engineers
Passive slab engineer: Tanner Structural Designs
Timber roof design: Cullen Timber Design
Passive house certifier: Warm Low Energy Building Practice
Airtightness tester: Paul Jennings (formerly of Aldas)
Straw bale construction: Straw Works
Aluminium roofing: EFL - Specialist Roofing Contractors
Roof insulation: Warmcel, installed by Payne Insulation
Floor joists: Easi-joists, via Holden Timber Engineering
Insulated foundations: Kore
Windows & doors: Livingwood
MVHR: Brink, via Passivhaus Store
Thermal store: Gledhill
PV: Sunmodule



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IN DETAIL

Building type: Two-storey detached straw bale dwelling, 148.3 sqm TFA with single-storey conservatory outside thermal envelope.

Passive house certification: Certified PH Classic (PHPP 9 PER Assessment)

Space heating demand (PHPP): 14 kWh/m²/yr

Heat load (PHPP): 10 W/m²

Primary Energy Renewable (PHPP): 63 kWh/m²/yr

Environmental assessment method: N/A

Airtightness (at 50 Pascals): 0.42 ACH or 0.47m³/hr/m²

Energy performance certificate (EPC): C78

Overheating (PHPP): 6%

Heat loss form factor: 3.22

Measured energy consumption: Electricity meter readings show the house consumes on average 4,622 kWh per year, while generating on average 3,956 kWh per year from its solar PV array.

Energy bills: Based on Dave & Mabel's average annual consumption of 2,365 kWh (day) and 2,256 kWh (night) and Powershop's Shop for Powerpack's tariffs of 12.4p and 7.1p respectively (as per switch.which.co.uk), the estimated average annual total energy bill works out at £512, including VAT and standing charges. According to PHPP, the house is estimated to consume 2,082 kWh per year for space heating, and because Dave & Mabel only run their electric space heaters at night (ie using night rate electricity of 7.1p), this would yield an estimated annual space heating bill of £160. (However, the house may be using far less space heating than PHPP assumes, as the total night time consumption is only marginally higher than the PHPP estimate for space heating). In 2017, Dave and Mabel received a feed-in-tariff of £627 for generating solar power in that year. Subtracting this from the calculated annual energy bill of £512 gives a net profit of £115.

Thermal bridging: ACDs not used. Foundations: no thermal bridging through use of minimum 100mm EPS formwork to concrete ring beam; first floor: metal web joists are not built into thermal envelope; gable walls: thermally-broken double stud construction; curved roof: thermally-broken double joist construction; window/external door jambs and heads: wood fibre insulated external reveals (for lime render finish).

Ground floor: KORE passive reinforced concrete raft foundation, with external ring beam and internal ribs, on 400mm EPS insulation, on 50mm sand blinding, on 550 to 750mm compacted blast furnace slag subbase. U-value: 0.081 W/m²K

Walls: 450mm nominal loadbearing straw bale, finished with 25mm nominal lime render externally and 25mm nominal lime plaster internally. Insulated box beams at first floor level and eaves level made up from timber joists and noggins, 18mm OSB flanges and full-fill mineral wool insulation. U-value: 0.114 W/m²K

Gable panels above box beams: 100 x 50mm double timber stud construction, finished with 25mm nominal lime render externally with mesh reinforcement on 25mm wood wool board, and 25mm nominal lime plaster internally with mesh reinforcement on 15mm wood wool board. Insulation: 410mm wide cavity injected with Warmcel. U-value: 0.100 W/m²K

Curved roof: Natural embossed aluminium standing seam sheeting on pro clima Solitex UM Connect underlay, on 2 x layers 9mm plywood, on 150 x 50mm timber joists, on 300 x 75mm curved glulam beams. 360 x 100mm glulam ridge beam. Ceiling construction: Gypsum plaster finish at bottom, on 9.5mm plasterboard, on Intello Plus airtightness membrane, on 6mm hardboard sheathing to underside of 150 x 50mm timber ceiling joists between curved glulam beams. Insulation: 450mm deep cavity injected with Warmcel. U-value: 0.095 W/m²K

Windows: Livingwood tilt & turn triple glazed alu-clad redwood windows, lift & slide door and entrance doors, with argon filled glazing. Overall U-value: 1.00 W/m²K

Heating system: Direct electric space heating: 1.8 kW MVHR post heater (bought directly from Veab) and 1.8 kW radiant heater to downstairs hall, both only run at night on Economy 7 tariff. Two x 1.2 kW Stiebel Eltron radiant heaters in two of the three bathrooms, used for comfort when showering.

Domestic Hot Water: Immersion heaters in 250 litre Gledhill Torrent Greenheat thermal store (as per detail in article).

Ventilation: Brink Renovent Excellent 300 heat recovery ventilation system with supply and extract plenums and radial ductwork; Passive House Institute certified to have heat recovery rate of 84%.

Electricity: 27 square metre Sunmodule Plus SW 250 mono black solar photovoltaic array with average annual output of ?? kW; Enphase M215 Microinverter.

Green materials: Compacted subbase used blast-furnace slag, a byproduct from steel manufacturing; straw bales supplied from an Essex farm; Warmcel recycled newspaper cellulose fibre insulation.



SLOPE & GLORY

When architect Tony Godwin wandered into a seminar on the passive house standard at Ecobuild ten years ago, it was the start of a journey that would eventually see him design and build his own passive home on a sloping site — and learn some hard lessons along the way to achieving a comfortable, ultra-low energy family home with tiny energy bills.

Words by Tony Godwin

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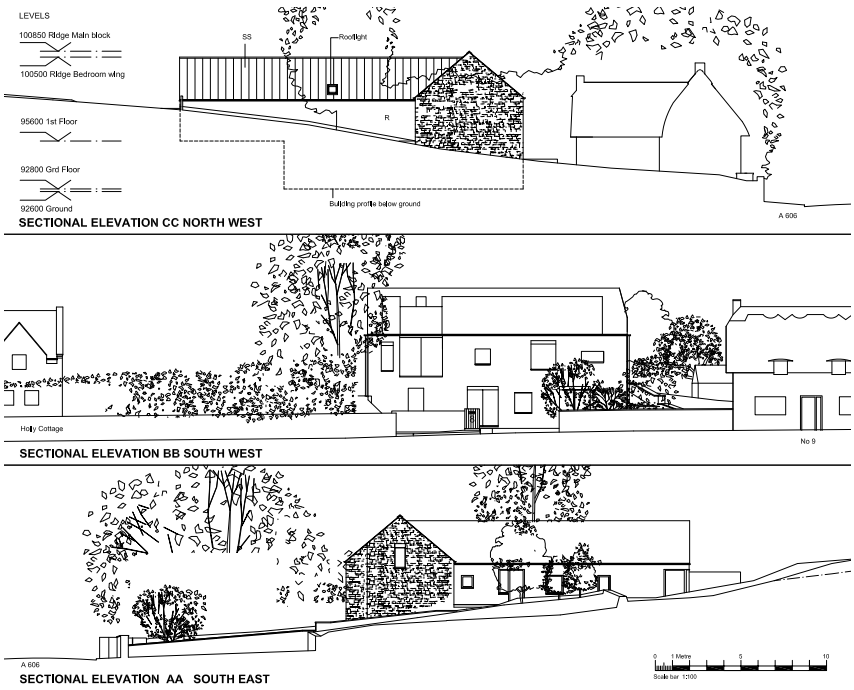
Per year
(all heating & electricity minus renewable energy income)

Building type:
221 sqm detached two-storey timber frame house

Location: Whitwell, Oakham, Rutland, UK

Budget: £508,000

Standard:
Certified passive house



> A teenager in a small room with an Xbox doesn't need further heating either.

Relocating from London to Rutland, my wife Marlen and I quickly realised that all the properties on offer would require either considerable compromise on our aspirations for a low energy sustainable lifestyle, or else radical alteration, adding considerable cost to the initial purchase price. So arose my wife's suggestion that we self-build.

Foreseeing a sentence of several years hard labour, I suggested sites would be difficult to come by. Undeterred, her internet search found four sites within four miles of our son's school, and so the fuse was lit.

Our brief was for a home with a minimum of three bedrooms for the family, an additional bedroom and bathroom to host parents or guests separate from the family accommodation, and a working space (as we both work from home). We wanted contemporary spaces that would be inspiring to inhabit, and we wanted to aim for the highest standards of energy efficiency and sustainability practical.

I first encountered the passive house concept at Ecobuild 2008, attending a seminar with Bere Architects. I arrived late as passive house expert Sarah Lewis took attendees through a lot of data sheets – and I left after 10 minutes thinking 'this is too difficult'!

We purchased our site in December 2009 and planning permission was granted the following May. The passive house option was kept on the table, and a brief email exchange with the BRE indicated that the standard was achievable for our design. Later in 2010, a visit to Bere Architects' Ranulf Road passive house, followed by a seminar with Professor Helmut Krapmeier, persuaded me to make the passive house standard the core requirement for our new house.







Disappointment followed as the first calculations in the passive house design software PHPP predicted a heating demand of 22 kWh/m²/year — well outside the passive house standard of 15 — because the proposed T-shape with single-storey projections resulted in a poor form factor. There was also a large proportion of glazing to the northerly aspect. These factors were compounded by the East Midlands climate zone, which has one of the longest heating seasons in the UK.

So our passive house advisors WARM suggested reconfiguring the house — essentially swapping the single-storey studio in front of the house for the garage. The redesign featured improved U-values with fabric thicknesses of up to 600mm, and required a new planning permission.

While it was still mid-recession and funds were locked up in our unsold London house, the revised scheme was approved and the lesson that passive house principles have to be integrated with the design process from the beginning was learnt — the hard way.

Building fabric

With the lower floor of the house built into the slope of the site, the external envelope had to have detailing for both above and below ground conditions, maintaining continuity of waterproofing, insulation and airtightness over a variety of external finishes while allowing for differential movement.

The wall solution comprises a 300mm double-stud structural timber frame filled with Warmcel set on the ground bearing concrete slab, and in front of a reinforced concrete retaining wall. Detailing was a challenge for both architect and, in implementation, the builder. With the exception of the epic 'Details for Passive Houses' book written by the Austrian Institute for Healthy and Ecological Building, published information in English was scarce, and I relied heavily on advice from pioneers in the UK passive house sector.

The build-up of the ground floor meanwhile, with the power-floated concrete slab sitting over EPS insulation, is designed to expose the slab internally and provide thermal mass that buffers against temperature fluctuations outside.

Sustainable development

The site – which is three-quarters of an acre, orientated north-west to south-east – slopes seven metres to the main road, and was blighted by previous development attempts. The upper 70% of the site is zoned as 'significant open space' in the village and was not open for development. Excavated material from the foundations was spread over this paddock area, rather than removing it from site – also a cost saving. From the outset we consulted with the village community via the parish clerk, which in a conservation area undoubtedly assisted with our planning application.

A 1,500 litre tank under the front drive collects all the rainwater from the roofs, and from there the water is pumped up to a larger storage tank at the top of the site which gravity feeds four garden taps. As far as possible we used local contractors and suppliers based within a 30 mile radius of the site, supporting the local economy and reducing site travel miles. We also have a solar thermal panel and a 3.5kW solar photovoltaic installation.

Construction, procurement and cost

Of the project team of consultants, constructors and suppliers, I had only worked with

Explained:

Form factor is the ratio of a building's total surface area (the walls, roof and ground floor) to its treated floor area. The smaller the form factor, the more efficient the shape of the building and the less surface area from which heat can escape. A form factor of under 3.0 is considered ideal for a passive house.

> The lesson that passive house principles have to be integrated with the design process from the beginning was learnt — the hard way.

Photography: FCD Architecture





the structural engineer previously. All were new to passive house except WARM and Green Building Store. As I expected, the contractor insisted that we use a quantity surveyor for valuations to avoid conflict of interest, and our QS became the contract administrator (we used a standard JCT contract with quantities), leaving me free to concentrate on site supervision and supply of information – and with hindsight, it was well worth the fees we paid.

I avoided nominating subcontractors so that the main contractor would remain responsible for all aspects of the project except for unfamiliar items critical to the passive house standard. We only sourced imported items though UK distributors who we assessed could provide reliable support during design and construction.

Prices obtained for the timber frame during the design stage revealed an apparent premium for systems developed for super-insulation and airtightness, and as timber frame is such a well-established building method, I reckoned we could get a better price by going through the main contractor. This proved to be a false economy, as it locked us into a manufacturer who would not modify their system, which was only designed to meet UK building regulations, and this ended up creating airtightness detailing difficulties. In hindsight, if we had chosen the timber frame supplier in advance, it would have allowed us to prepare the design of the frame before appointing the main contractor, thus avoiding the delays that resulted.

Procuring the triple glazed windows from the manufacturer Katzbeck in Austria was a lengthy process due to indirect communication through the UK installation representative. In future, I would always make time to visit the manufacturer. Note that tilt or lift-and-slide windows are difficult to make totally airtight due to the mechanisms involved. We now have two in our living area, and it is noticeably cooler here on really windy winter days.

Fortunately the contractor's site agent, as well as being a skilled builder, remained open-minded and collaborative on the unfamiliar territory of a passive house build. But only previous experience could have prepared us for the level of airtightness detailing required. We air-tested on completion of the airtight layer, and – mistakenly measuring the internal volume according to the UK building regulations – thought we had passed the passive house target. We then carried out three further tests, with many hours spent finding and rectifying leaks before finally achieving the required value of 0.6 air changes per hour.

Another lesson we learned is that proposed substitution of specified insulation material must be reported and agreed. In our case, the mineral wool in the roof was built up in layers of different thicknesses with different lambda values and the contractor varied these, resulting in a loss of U-value.

For the sake of certainty, I selected a passive house certified Paul MVHR system, designed and supplied by the Green Building Store, and would still look no further if I was choosing one again.

Real-world performance

There is no doubt that designing and constructing to the passive house standard requires a cultural shift from normal UK industry practice. The process is unforgivingly rigorous, and allows none of the 'ducking and weaving' possible under Part L. 'There or thereabouts' certainly will not

> The maximum summer temperature we've recorded in the living area is 26C, and then only for a few days.

do. If your building does not perform as modelled, look for deficiencies in the design and construction — not PHPP.

That the topic of 'summer overheating' was a favourite on the seminar circuit last year indicates that architects have perhaps been taking design licence from the PHPP criteria that internal temperatures must not exceed 25C for more than 10% of the year, and that this could be tightened up. In our case, with quite large south-west facing windows, I built external aluminium horizontal louvre electric blinds into the façade, which are controlled by a simple sunlight sensor. With these deployed the maximum summer temperature we've recorded in the living area is 26C, and then only for a few days (PHPP gave our frequency of overheating as just 0.3%, or about one day).

If your design, as mine does, has a poor form factor (and if you want a vaulted ceiling!) you will have to achieve better U-values. That our master bedroom and guest bedroom — at opposite ends of the L-shape plan with a higher proportion of external envelope — are cooler than the rest of the house is perhaps logical but nonetheless wasn't expected (even temperatures being promoted as a benefit of living in a passive house). However the differential is never more than 2C.

In comparison our studio is heated nicely by us and our office equipment during the day, and a teenager in a small room with an Xbox doesn't need further heating either. We have a traditional gas-based central heating system with three heated towel rails and three radiators, all thermostatically controlled, and we have a frost protection heater battery on the ventilation system.

Temperature readings taken indicate that heat is only required when the external temperature falls to 7C or below, and we've found it is better to set the boiler programmer to 'on' all the time, and let the remote digital thermostat call for heat and fire up the boiler when required. The thermostat is left in the living area at 21C and moved to the master bedroom (which has a radiator) at night and set at 19C.



Overall, this is more efficient than setting the boiler to turn on and off during the day, because if we switch the boiler off it takes ages to bring the temperature up again, even though we are only dealing with a drop of 1 or 2C.

However, this heating provision has struggled to keep up with sudden changes of temperature this winter, and in the very cold weather front from Russia earlier this year, it took a day to shift the temperature in the living area from 19.5C to 20.5C. This was not helped by the north-east wind finding the unsealed end of our four-metre wide lift and slide window. It should be noted that the stated occupancy of the house for PHPP was six, but is now normally two (meaning there are less internal heat gains from the body warmth of occupants than designed for).

Our energy bill averages £900 or £4 per square metre, and is offset by earnings from renewables, leaving us with a net annual energy bill of £250. What's more, our energy usage now is well within that predicted by PHPP.

In my opinion, if there is one disadvantage with living in a passive house, I think it is that as an occupant one's body comes to expect the high standard of thermal comfort the standard delivers — and becomes physiologically less tolerant of lesser environments, especially draughty ones. But as one of our visitors exclaimed during an International Passive House Open Day: "why would anyone not want to build a passive house?"

CONSTRUCTION IN PROGRESS



1 The view south-west over the three-quarters of an acre site, which slopes seven metres to the main road; **2** the floor build-up features 200mm EPS insulation, increasing to 350mm under the reinforced concrete slab; **3** the retaining walls are tanked with Visqueen self-adhesive tanking membrane, insulated externally with 100mm of expanded polystyrene, and protected with Visqueen Protect and Drain membrane.

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SELECTED PROJECT DETAILS

Clients: Tony and Marlen Godwin
Architect: FCD Architecture
Passive house designer: WARM Low Energy Building Practice
Quantity surveyor: ADM Surveyors Limited
M&E design: EDP Consulting limited
Main contractor: DW Hicks Building Co Ltd
Timber frame: Harlow Ltd (design, manufacture, erection)
MVHR: Paul, supplied by Green Building Store
Ventilation system installation: Dave Manby
Cellulose insulation: Warmcel
Glass & mineral wool insulation: Knauf & Rockwool
Windows & doors: Katzbeck, supplied by JLH
Roof window: Fakro
Airtightness products: pro clima supplied by Green Building Store
Solar evacuated tubes: Worcester Bosch via Envirogen Ltd
Solar photovoltaic panels: Solarworld via Envirogen Ltd
Rainwater harvesting: Rainwater Harvesting Ltd

CONSTRUCTION IN PROGRESS











1 Erection of the timber frame in progress; **2** the Durelis VapourBlock board features a factory fitted transparent airtightness and vapour control layer on one side; **3** service penetration taped and sealed with pro clima Tesco tape; **4** rigid ductwork for the Paul Novus 500 mechanical ventilation heat recovery system installed in the metal web joists; **5** use of Marmox thermal break boards around the lightwell to cut out thermal bridging.



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IN DETAIL

Building type: 221 sqm detached two-storey timber frame house with semi-basement.

Completion date: April, 2015

Budget: £508,163

Passive house certification: Certified

Space heating demand (PHPP): 15 kWh/m²/yr

Heat load (PHPP): 9 W/m²

Primary energy demand (PHPP): 79 kWh/m²/yr

Heat loss form factor (PHPP): 3.38

Overheating (PHPP): 0.3%

Environmental assessment method: Nil

Airtightness (at 50 Pascals): 0.6 ACH @ 50 Pa

Energy performance certificate (EPC): A93

Measured energy consumption: Measured average annual gas consumption of 4,587.44 kWh and electricity consumption of 6,964.33 kWh (total of 11,551.77 kWh or 55 kWh/m²/yr. Adding back estimated contribution from solar thermal (estimated as per MCS methodologies) and solar PV (50% of generation as per SAP 2009) of 3,084 kWh/yr combined gives a total energy consumption of 14,636kWh (or 66kWh/m2/yr) compared to PHPP design figure of 17,476kWh (or 79 kWh/m²/yr).

Thermal bridging: Thermal bridges were designed out by careful detailing with the assistance of the passive house designer. The edges of the raft floor slab are wrapped with a minimum of 200mm EPS insulation; the junction of slab and retaining wall was wrapped with an additional 100mm of EPS (total 300mm); retaining walls extending beyond the building were disconnected from the main structure and masonry built off the top of the retaining wall was isolated using Marmox blocks. There is no steel in the superstructure although there was a concern about the extent of gang nails plates used in the truss forming the main vault. The mass was calculated and the effect was negligible. The windows frames are solid Spruce and lapped with insulation externally. Y-value: 0.003 W/(m²K)

Energy bills (measured or estimated): Average annual gas bill (heating and hot water) of £267.85 and electricity bill of £633.49 (averaged over three years) = total average annual energy bill of £946.73. Average annual feed-in-tariff (for solar PV £429.69) and renewable heat incentive (for solar thermal) of £220.26. Subtracting these figures from £946.73 yields a net average annual energy bill of £251.39 or £21 per month.

Ground floor: 150mm compacted base followed above by 50mm quarry stone fines as blinding, DPM / radon barrier, 200mm EPS in 2 x 100mm layers (increasing to 350mm under the slab), 150mm reinforced concrete slab with 300mm deep x 600mm perimeter beam and 300mm x 1200mm structural 'toe' reinforced up into the retaining walls. Slab is power floated with a dry shake surface hardener topping. U-value: 0.148 W/m²K

WALLS

The house is cut into a sloping site. The structure comprises a double stud timber frame bearing on a concrete slab located in front of reinforced concrete retaining walls made structurally integral with the slab. Timber frame is clad externally with three different finishes.

Main front elevation (from inside to out): 12.5mm plasterboard, 37mm battened service void, 12.5mm P5 Durellis vapourblock (airtight) OSB board, 63mm non-loadbearing stud + 97mm void + 140mm loadbearing stud forming a 300m void filled with Warmcell recycled newsprint insulation, 12.5mm P5 Durellis OSB board, 100m mineral wool insulation, 50mm airgap, 110mm local Clipsham limestone. U-value: 0.099 W/m²K

Rear elevation: Timber frame structure as above but clad with 150mm mineral wool insulation between cross battening, moisture barrier membrane and Rockpanel boards in shiplap arrangement. The wall to the boundary is similar, with thin-coat through-colour render on 10mm cement board. U-value: 0.088 W/m²K

The retaining walls are tanked with Visqueen self-adhesive tanking membrane insulated externally with 100mm of expanded polystyrene protected with Visqueen Protect and Drain membrane. U-value: 0.087 W/m²K

ROOF

The main roof structure is a vaulted truss fully insulated. The build-up from inside to out is: 12.5mm plasterboard, 37mm service void, 12.5mm P5 Durellis OSB board, 550mm glass mineral wool, 60mm Rockwool Hardrock Multifix (DD) board, counterbattens + breathing moisture proof membrane + battens (70mm), plain fibre cement slates.

The wing to the rear has a similar attic truss with a void over the insulation. The build-up is similar but with 40mm counterbattens (providing a ventilation airgap), 12.5mm plywood, geotextile membrane and standing seam aluminium roofing. U-value: 0.074 W/m²K

Windows & doors: Linea by Katzbeck windows sealed with pro clima tapes. Frame: Spruce wood-powder coated aluminium with Uf-value of 1.1 W/m²K. Glazing: Interpane iplus E, 90% argon filling, Ug-value of 0,5 W/m2K, g-value of 5%.Turn & tilt window overall U-value: 0.78 W/m²K. Fixed window overall U-value: 0.72 W/m²K. Front door overall U-value: 1.2 W/m²K

Roof window: 1 x Fakro FTT U8 Thermo passive house-certified quadruple glazed roof window. Whole window U-value: 0.58W/m²K

Heating: Worcester Bosch gas boiler 12i 24Kw 'wet' distribution to 3 Uniline panel radiators and 3 MHS heated towel rails. Gas boiler also serving Worcester Bosch 210L hot water cylinder with dual coil indirect heating. Worcester Bosch Solar-Lux 12 (12 evacuated tube) solar thermal system also serving same hot water cylinder via indirect heating coil. Estimated annual output of 1,112 kWh.

Electricity: 3.5kWp solar photovoltaic array with 14 Solar World mono crystalline panels in-roof mounted. SMA inverter: Sunnboy 3000HF. Estimated annual output using SAP of 3,363 kWh.

Ventilation: Paul Novus 500 mechanical ventilation heat recovery system with frost protection.

Water: All rainwater is collected for garden irrigation in a 1,500L tank with an automatic pressure switched pump. A 5,000L tank located at the top of the site is fed from the lower tank. Water is then distributed by gravity to locations in the garden and paddock as required.

Sunshading: Hunter Douglas aluminium horizontal motorised venetian blinds controlled by manual switch or sun or temperature movable sensors stuck to the glazing located according to user preference.

Green materials: The overriding criteria in the selection of insulation materials was to avoid the use of those based on petro-chemicals. Thus Warmcel recycled newsprint was used on the walls and mineral or glass wool elsewhere. Petrochemicals could not be avoided below ground and EPS was specified as it has a more environmentally friendly manufacturing process. The timber frame superstructure was chosen to avoid steel or masonry.





SOUTH DUBLIN PASSIVE HOUSE

RISES OUT OF THE ORDINARY

This skilfully designed new passive house in Blackrock manages to be light-filled and strikingly contemporary while taking its design inspiration from the very ordinary Dublin street on which it sits.

Words by John Cradden

€383
Per year
(space heating & hot water)

Building type:
180 sqm timber frame passive house

Budget: €380,000

BER: A3

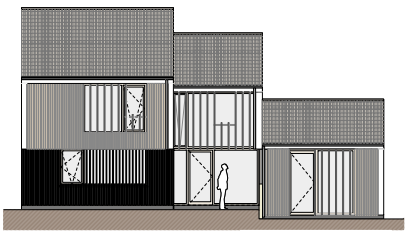
Standard:
Certified passive house



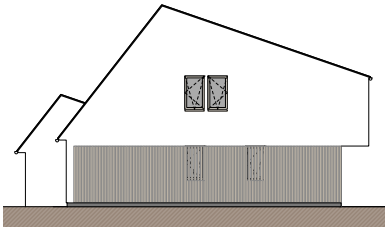
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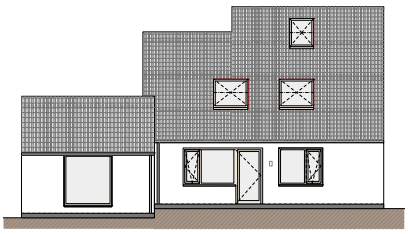
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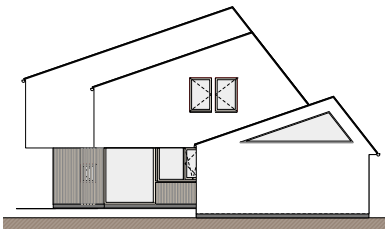
SOUTH ELEVATION



WEST ELEVATION



NORTH ELEVATION



EAST ELEVATION

Dún Laoghaire-Rathdown will be well known by now to regular readers of Passive House Plus as the first local authority in Ireland to put the passive house standard into its planning requirements.

Although that measure was formally adopted early in 2016, architects and Blackrock residents Stephen Tierney and Nicola Haines had long before decided that their new house would be passive house certified.

"We were indeed thinking about passive earlier and for quite a while," says Tierney. The married couple are also partners in business, running Tierney Haines Architects together. "A lot of our clients had been asking us about it for several years, so we were keen to have the house as a kind of experiment to share with clients.

"We were also keen to achieve a fully certified passive house as it seemed to be timely and the right thing to do, and we needed to have some real experience of the [certification] process."

The site was bought in 2015 after a search that took some ten years. "The problem was, of course, that most sites in south Dublin already have planning for as many townhouses as can be crammed on," says Tierney. "We wanted a site with enough

space for a house and garden, but they were all too expensive because they had planning for two or three houses."

But their patience was rewarded when they found a big site in Brookville Park with restricted, shared access. This meant that there could only ever be planning for one house, making it much more affordable.

The house they built, which also serves as the office for their firm, is rather stunning, not just in terms of its overall design but for how unobtrusively it sits amid its immediate surroundings.

The idea of the distinctive and stepped three-form shape was to make the most of the curved site in combination with planning restrictions regarding the use of local materials, height limits and the need to adhere to building lines. The angle of the shallow roof, for instance, is cleverly aligned with the dormer roofs of neighbouring houses.

The most striking single feature is the larch and Durawood timber cladding at the south-facing front. The timber louvres function both as shading and for privacy from the busy traffic junction opposite.

And even though the final result is highly contemporary and unique, it still manages to reference the pebble-dashed house next door.

"From an external point of view we wanted it to be a house that in some respects echoed surrounding buildings and remained quiet — particularly as you look at it from the west — and in another way had a very particular quality and its own character. We generally design quiet buildings that are connected to their local landscape."

The decision to eschew concrete or cement in favour of twin-stud timber frame construction – with no outer leaf of masonry – as well as choosing timber cladding and cellulose [recycled newspaper] insulation, was as much to do with aesthetics and practicality as the fact that these materials have a smaller ecological footprint.

"We didn't want to complicate the detail of the passive slab by having an outer leaf of concrete block. There is a satisfying density to the cellulose insulation and we had used it before for many years. The larch cladding is another favourite of ours and we treated it with Sioo [a high-quality wood protection] to give an even silver aging which ties it in quietly with the Durawood louvres, the concrete roof tiles, and the tone of the off white acrylic render — as quiet as possible to accentuate the planting and quality of light."

Handily enough, Tierney Haines Architects also design gardens and the couple aimed to make the most of both the front and back garden spaces while creating a close connection between outside and inside.

The 180 square metre house has minimal circulation areas to maximise the floor space. Meanwhile, the office is at the front and can be reasonably well isolated from the family activity at the back of the house.

There is also a double height hall, sitting room and upstairs landing, while one of the bedrooms has a mezzanine level, and all take advantage of the house's southerly orientation.

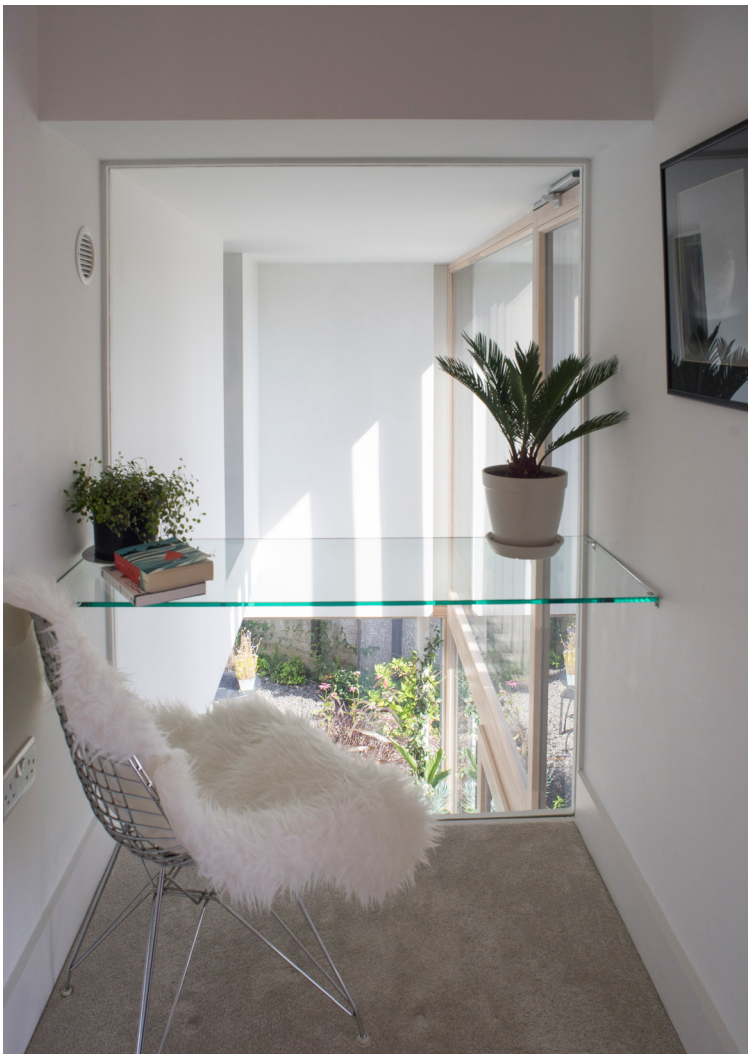
Passive house consultant on the project, Andrew Lundberg of Passivate, particularly likes the double height space. "I mentioned to Stephen and Nicola once during the process that the use of double height spaces is a compromise on efficiency, as it's floor area that could otherwise be used.

"However it was clear that this was an important part of the design that wasn't going to go away, and in the overall context of the house nothing extraordinary had to be done to compensate for it.

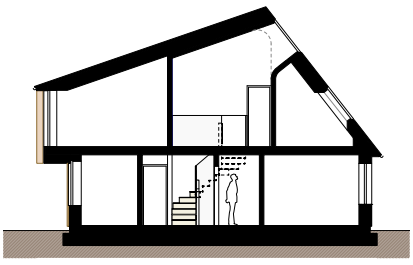
> We generally design quiet buildings that are connected to their local landscape.



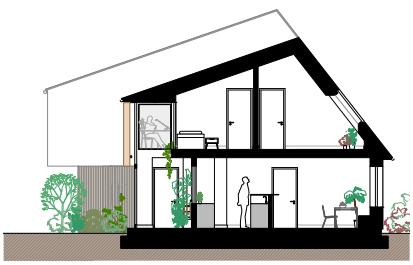
Photography: Stephen Tierney







SECTION 1



SECTION 2

"As it's fully glazed it gets a lot of sun, but is essentially isolated from the main part of the building so it's just a nice space to sit in that actually has a very different feel to the rest of the house, and that's actually very uncommon in passive houses where temperatures are normally very consistent all around."

The house also breaks new ground in that it may be the first certified passive house to use Vaventis Fresh-r ventilation systems (the house has two). These are decentralised heat recovery ventilation (HRdV) units that are installed in specific rooms, unlike traditional centralised systems which have one ventilation unit and a duct network running throughout the house.

The unit serving downstairs is situated in the main living space and TV room, while the unit serving upstairs is in the (downstairs) utility room, with a short duct run from here to the upstairs bathrooms, and another duct run to the adjacent ground floor bathroom and office.

Incoming fresh air enters through the warm utility room, and Tierney says the constant movement of warm air here dries clothes quickly. Doors between rooms are also left open at night to help ventilate the bedrooms.

The two Vaventis units are capable of delivering 20 to 65 m^3/hr of fresh air each – and for this 180 sqm house three units would ordinarily be recommended, especially given the fact the building also includes the Tierney Haines office, where Tierney and Haines work during the day along with two colleagues.

"We designed the office to have cross ventilation," says Tierney. "We put in a little vent window – 400mm by 300mm – near the front door. That gives a little cross ventilation across the desk when you need it. If there are three or four in there, that window might be ajar for half a day."

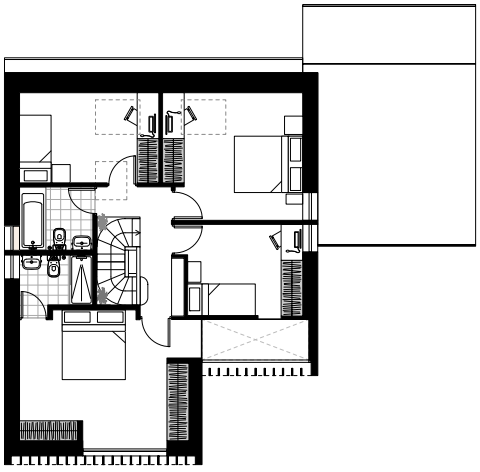
In the summer, for cooling purposes, the high-level window in the hallway helps to provide a stack effect, in addition to the remote controlled Velux roof-windows. In addition, the louvred window in the downstairs toilet tends to be left open in the summer, and the stack effect from the landing roof-window helps to draw cool air from here around the ground floor.

Tierney also points out that the super-insulated structure provides excellent acoustic insulation from the traffic outside. "It is many people's first comment on entering – how quiet it is," he says.

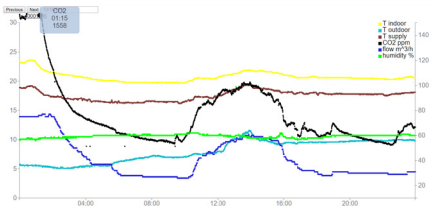
Tierney and Haines have been living in the house for a year now and are delighted. "We like the light most and how there is a different atmosphere at every time of the day. The advantage of an end of terrace site is that we have a lot of open sky giving us a very bright site."

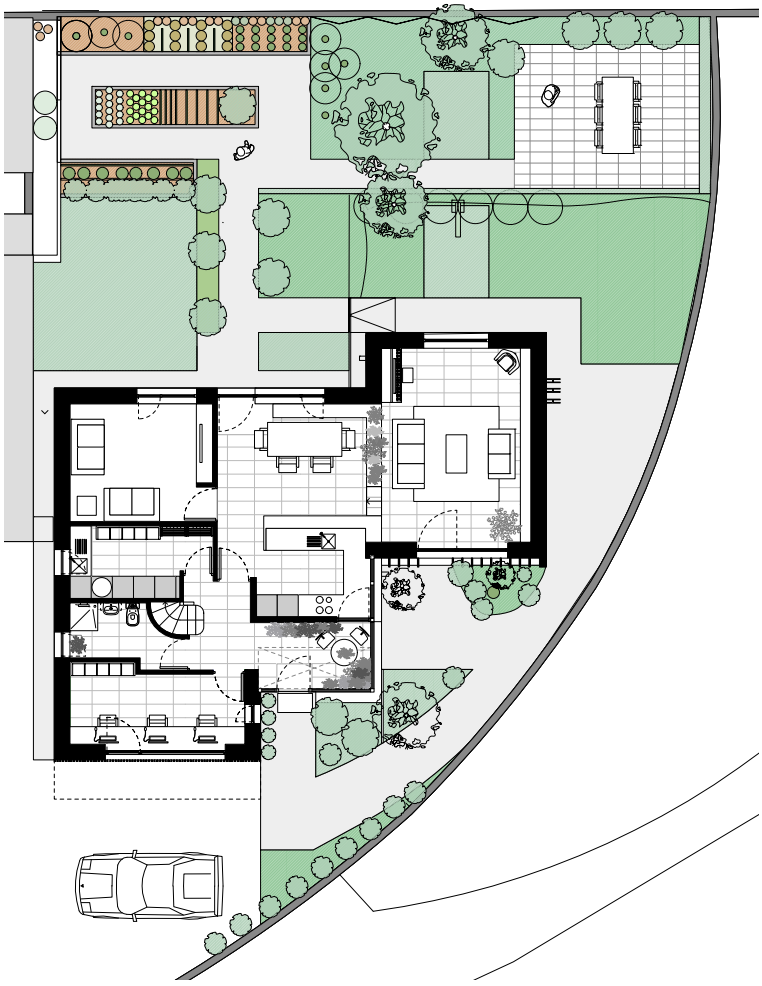
He says that he and Haines "constantly delight" in the steady temperatures of 20-21C

> The advantage of an end of terrace site is that we have a lot of open sky.



FIRST FLOOR PLAN





GROUND FLOOR PLAN



Explained:

Stack effect: The movement of air in and out of buildings due to differences in the temperature or moisture content of air. For example, the opening of high-level windows can allow warm air to rise out of a building, creating a 'stack' or 'chimney' effect that pulls cooler outdoor air in through open windows down below, helping to provide ventilation.

downstairs and 18-19C in the bedrooms, adding: "The steadiness of it is one of the biggest joys, no warm times and cold times, no cold spots or warm rooms, it means we lead a more open plan existence, open doors, enjoying the full volume of the spaces."

SELECTED PROJECT DETAILS

Architect: Tierney Haines Architects
Passive house consultant: Passivate
Engineering:
Tim Kelly Consulting Engineers
Passive house certifier:
Passive House Academy
Airtightness testing: Hession Energy
Main contractor: Smartbuild
Mechanical contractor: B Warm
Cellulose insulation: Ecocel
Floor insulation: KORE
Windows & doors: True Windows
Roof windows: Velux
Timber frame: Doherty Timber Frame
OSB: SmartPly
Airtightness products:
Alfa, via Proline Architectural Hardware
Condensing boiler: Wolf
Decentralised heat recovery ventilation:
Vaventis
Timber cladding:
Machined Timber Specialists
Limestone flooring: Kilkenny Limestone
Roof tiles: Blue Bangor

What does the data say on IAQ and energy use?

Data logging from the two Fresh-r units shown to Passive House Plus – both of which log CO_2, humidity, (indoor, outdoor and supply) temperatures and flow rate – indicate that the building is performing well. Indoor temperatures rarely creep above 25C in the summer, while winter temperatures tick over at between 18-20C (for the unit serving bedrooms) and 20-22C (for the unit serving the main living area).

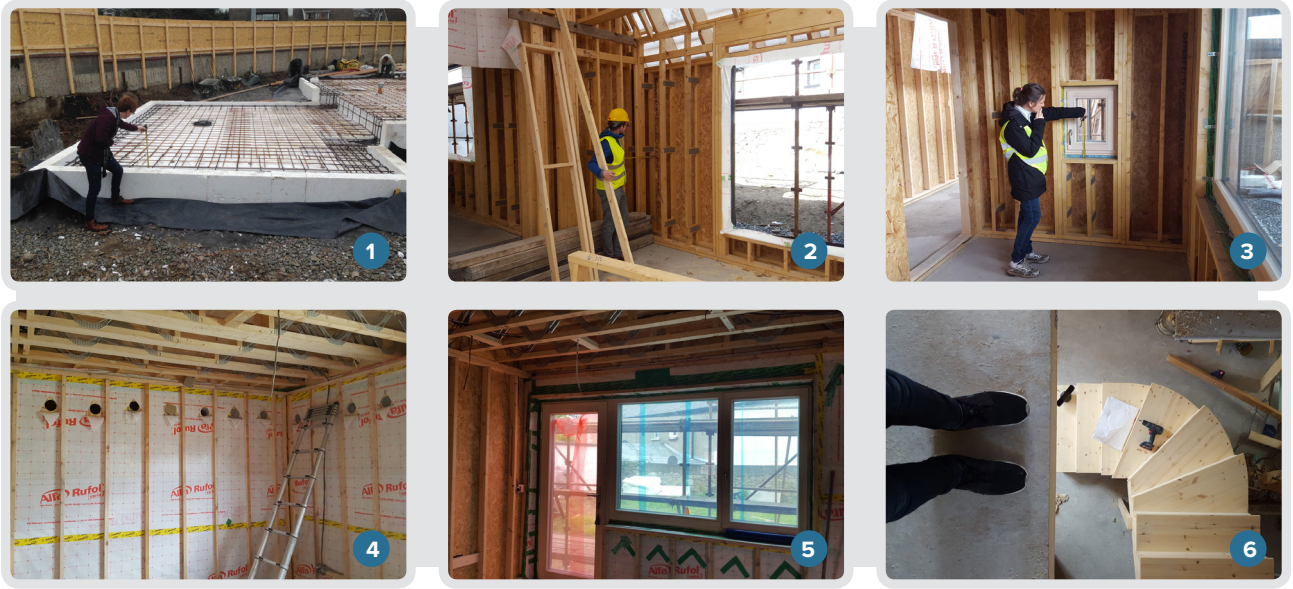
Indoor air quality levels look similarly consistent. CO_2 levels are notably lower in the warmer months due to the added impact of window opening, typically ranging from 400 to 700ppm, with the unit that serves upstairs peaking as the family rises in the morning. As the house closes up in the winter months, CO_2 levels raise, but seldom go above 1,000ppm. Passive House Plus queried one December event when night-time levels in the living area spiked at over 1,600ppm and temperatures rose to 23.5C. "We had a party with 25 people here," says Tierney, checking his diary. "Obviously after a while you open a few windows."

With constant access to the wifi-connected units performance data, Tierney says it's possible to glean remarkably detailed information on occupancy patterns. "The Fresh-r HRV monitoring is extremely sensitive and even allows us to see if one of our boys got up during the night to go downstairs and check their phones for social media updates."

As for primary energy, when the electricity factor is adjusted to be consistent with PHPP, the total metered primary energy use is uncannily close to the levels predicted in PHPP – the building used 107 kWh/m²/yr in its first year, just over 1 kWh higher than PHPP predicted (though the real figure would be just 91 kWh/m²/yr, based on the current Irish electricity conversion factor).

While at first glance the gas and electricity bills of €383 and €1,005 respectively appear higher than the incredibly low figures posted for some buildings covered in Passive House Plus, there are mitigating circumstances, notwithstanding extra energy use in the first year due to the building drying out and the occupants learning how to run the building. And the occupancy is high, given the building's dual role as a five-person family home and a four-person office. The office computer use alone is estimated at over 1,000 kWh/yr, representing roughly €150 worth of electricity per year.

CONSTRUCTION IN PROGRESS



1 The passive slab foundation features 100mm concrete raft/screed over 300mm of Kore EPS 100 insulation; **2** walls are twin-stud timber frame incorporating 300mm of Ecocel cellulose insulation; **3** windows fitted into place, sealed with airtightness tapes; **4** Alfa Rufol Varia vapour control layer in place, with holes for Ecocel insulation visible; **5** the holes are then carefully sealed up and taped over once the insulation is installed; **6** a Hitchcockian view down the under-construction timber steps from first floor to ground floor.





IN DETAIL

Building type: Detached 180 sqm timber frame four-bedroom family home and office.

Location:
Brookville Park, Blackrock, Co Dublin

Completion date: November 2016

Budget: €380,000

Passive house certification:
Certified passive house classic

Space heating demand (PHPP): 11 kWh/m²/yr

Heat load (PHPP): 10 W/m²

Primary energy demand (PHPP):
105.83 kWh/m²/yr

Heat loss form factor (PHPP): 2.408

Overheating (PHPP): 0.38%

Energy performance coefficient (EPC): 0.374

Carbon performance coefficient (CPC): 0.337

BER: A3 (58.06 kWh/m²/yr)

Energy bills (including all taxes and charges): €1,005 per year for electricity, €383 per year for gas.

Measured delivered energy consumption: 4,933 kWh/yr (metred gas use), 5,141 kWh/yr (metered electricity use).

Measured primary energy consumption: 107 kWh/m²/yr

Airtightness: 0.56 ACH at 50 Pa

Thermal bridging: Passive slab used which connected well with a twin-stud timber wall. The twin-stud timber frame meant that there was optimal reduction of thermal bridging at joints. In addition, a 50mm insulated service cavity was used internally.

Ground floor: 100mm concrete raft/screed over 300mm of Kore EPS 100 insulation. U-value: 0.117 W/m²K

Walls: 20mm larch cladding externally, followed inside by cavity, breather membrane, OSB, double-stud timber frame incorporating 300mm of Ecocel cellulose insulation, SmartPly OSB, Alfa Rufol Varia vapour control layer, 50mm insulated service cavity, plasterboard internally. U-value: 0.11 W/m²K

Roof: Sandtoft Standard Pattern Brown concrete roof tiles on battens and counter battens, followed underneath by breather membrane, double joist structure incorporating 350mm Ecocel cellulose insulation, Alfa Rufol Varia VCL, 50mm insulated service cavity, plasterboard. U-value: 0.1 W/m²K

Windows: True Windows IV98HPL aluclad timber windows, featuring Saint-Gobain Planitherm XN triple glazing. Ug-value: 0.54 W/m²K. Uf value: 0.99 W/m²K. G-value: 54%.

Roof windows: 3 x Velux GPU 0066 triple glazed roof windows. Uw-value: 0.82 W/m²K

Heating system: Wolf FGB-28 [92% efficient] gas boiler, 300 litre cylinder, heating through underfloor heating pipes to ground floor only.

Ventilation: 2 x Vaventis Fresh-r decentralised MVHR units. Passive House Institute certified at 78% efficient.

Electricity: No photovoltaic at present but planned for the future.

Green materials: Ecocel cellulose insulation, timber frame, FSC certified cladding (Durawood louvres treated with Sioo:x and untreated Siberian larch).



WANT TO KNOW MORE?

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The digital magazine is available to subscribers on www.passive.ie

THE GALWAY PASSIVE HOUSE

INSPIRED BY A WATER TOWER

Generational differences in taste were successfully married by a concern for energy efficiency in this contemporary, award-winning passive house in An Spidéal, which comes within a whisker of the nZEB standard.

Words by Jason Walsh



€250
Per year
(heating & hot water)

Building type:
200 sqm blockwork house with external insulation

Location: An Spidéal, Galway

Budget: €310,000

Completed: November 2015

Standard:
Passive house (cert pending)

Túr Uisce was designed as a house of contrasts: a contemporary design located in the rural Gaeltacht idyll of An Spidéal; a modern design that balances the ludic with the brut; and a self-consciously contemporary structure that takes energy use as seriously as it does form. The house won the sustainability award at the inaugural Building and Architect of the Year awards last year.

Architect Helena McElmeel says that the decision to build an ultra-low energy building was one the clients had already made, rather than it being a case of her broaching the idea to the bewildered.

"The clients were a father and son, so there were two generations at play, and that was interesting. The passive element was very important to the father, a priority for him. In fact, when I first met him he had [an edition of] Passive House Plus on the windowsill," she says.

The dramatic contemporary aesthetic took a little longer to come together, however. "We started with more of a vernacular reference, yet still modern, but that evolved to where it is now."

Where it has evolved into is a modern design with significant use of glass and a cantilevered upper storey resting across the ground floor, a site-specific element that evolved from visits to the locale.

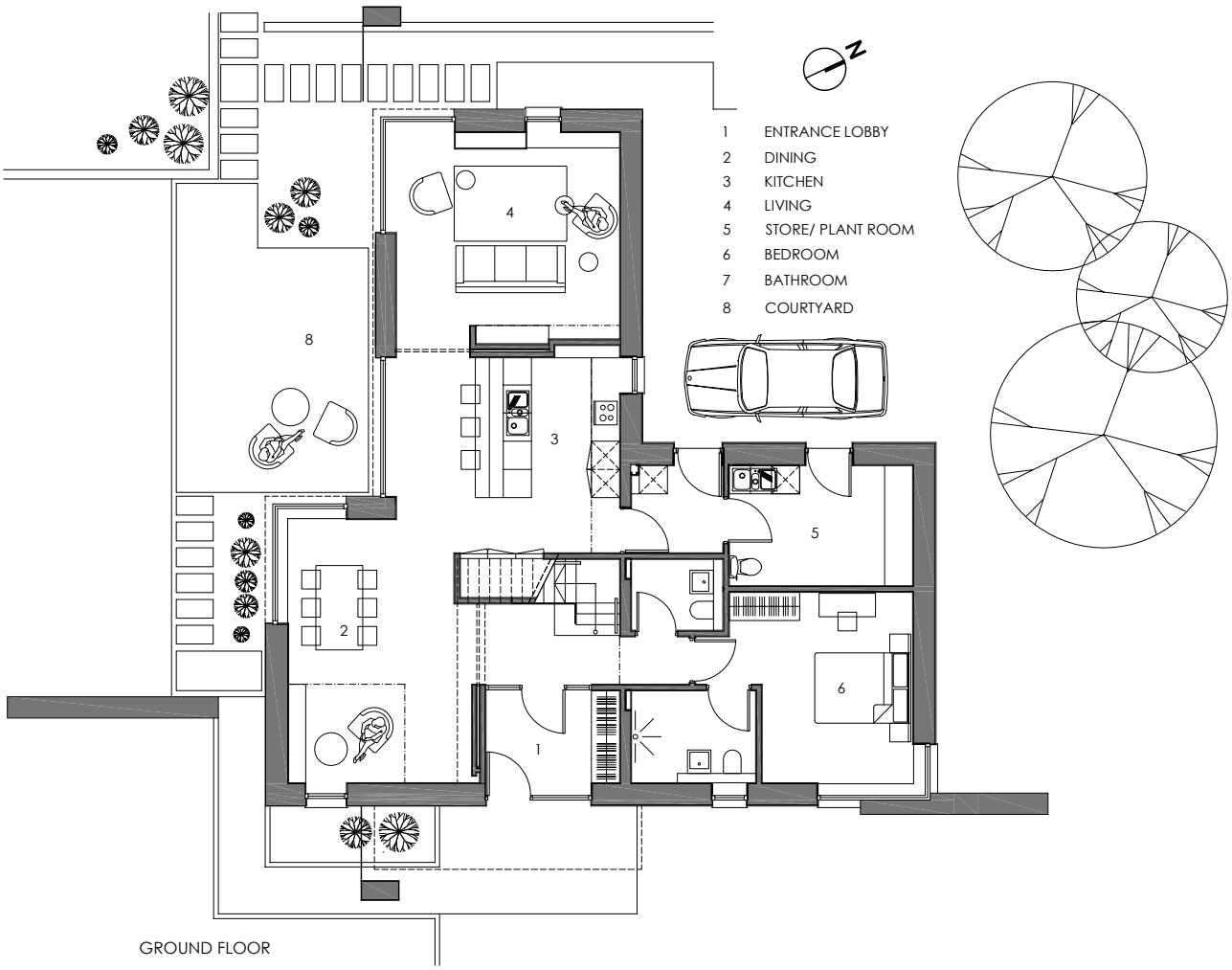
"The site is in front of the owners' previous house. The idea of the perching came from the site itself, with the hill behind and the old water tower up there. It's a play on something feeling a bit precarious," says McElmeel.

McElmeel's architectural practice has emphasised energy efficiency for some time. "I've had an interest in it. The first low energy house I constructed was in about 2008, which is when it first came into my radar. Around that time I did the master's [of architecture, in advanced energy and environmental studies] at the Centre for Alternative Technology in Wales," she says.

Nonetheless, and despite changes to the socio-political climate, certain aspects of sustainable building remain a hard sell in Ireland, she says, such as the environmental impact of materials.

"In an ideal world we would be building a lot of buildings with lower embodied energy

> The idea of the perching came from the site itself, with the hill behind and the old water tower up there. It's a play on something feeling a bit precarious.



GROUND FLOOR



> The design is incredible: even when you're inside, you feel like you're sitting in the garden.

[but] the costs associated... put people off, and there are cultural issues too."

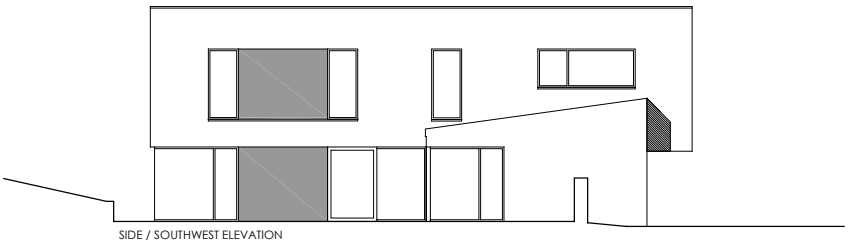
In the case of Túr Uisce (Irish for water tower], McElmeel focused on a super-insulated and airtight building fabric in order to allow for dramatic facades, significant use of glazing, and an overall form that was not simply a cube — while nonetheless ensuring that energy use remained very low.

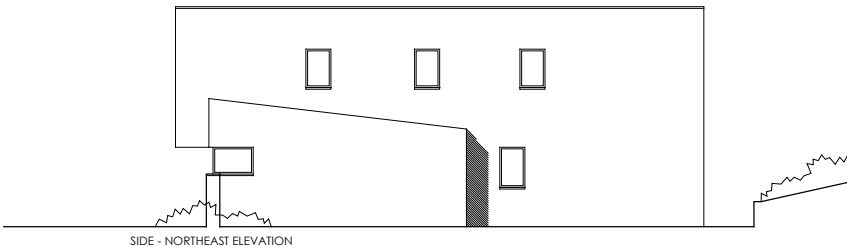
"When you have this form of design, one that's quite contemporary, external insulation helps as all of the elements, such as the large windows, are within that inner leaf. Also, in terms of airtightness there was work to be done. There were challenges with the structural elements, but they were all dealt with in the end. The contractor's understanding of airtightness and his commitment to it was essential," she says.

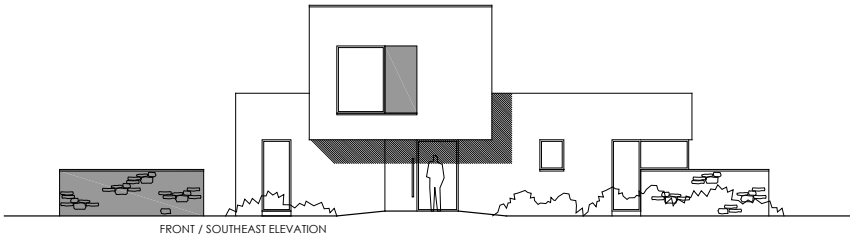
From the owners' point-of-view, things could not have gone better. Joe Folan, the senior of the father-and-son duo, told Passive House Plus that his time in the house, which achieved an A2 BER and came within a whisker of meeting the nZEB standard – has been ideal.

"I'm two years in the house now [and] it's absolutely fantastic. It's the most comfortable house you could possibly live in. There's nothing I would do to change it," he says. High praise indeed.

Folan and his son built this house on the site of their existing family home after

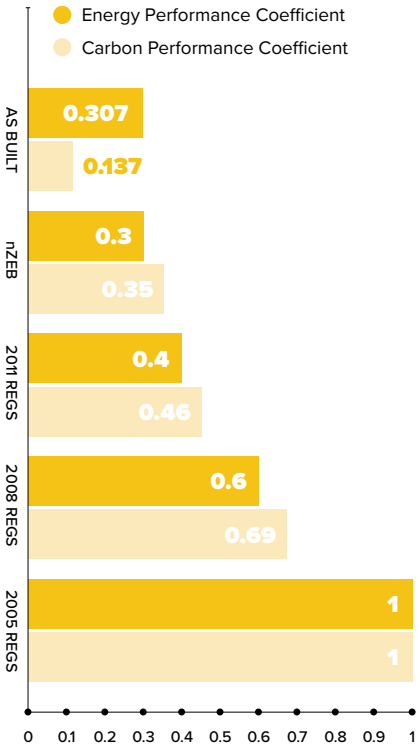






Photography: www.kelvingillmor.com





Folan's wife passed away. "We lived in the rather large house, and we had a site next to it. What we aimed for was a smaller house that's maintenance free," he said.

The decision to focus on a low energy dwelling was, he says, a joint decision, driven in part by the fact that the previous house was anything but low energy.

"The previous house was built about 30 years ago [and] there's a huge difference. You couldn't compare it. As for the contemporary, modern even, styling, Folan says that it lends itself to a different mode of life. "The design is incredible: even when you're inside, you feel like you're sitting in the garden."

Construction was by noted Galway-based builders GreenTec, a company with no shortage of low energy and passive house experience, as long-time readers of this magazine will attest. "Nearly all my work is passive house," says director Niall Dolan.

Despite its modern design and commitment to environmental standards, some aspects of the house are relatively traditional. For example, rather than timber frame, Túr Uisce's building fabric is blockwork – albeit in a single leaf, rather





than the more conventional cavity wall approach.

"It's blockwork with external insulation. The management of the build process is the main issue with houses like this: there's a lot of detail with airtightness and so on that has to be got right. Quality control is the main thing. You have to have a full time project manager on-site all the time, so in that regard it's unlike factory built houses," Niall Dolan says.

With Túr Uisce, achieving the passive house standard meant taking decisions that would protect the integrity of the design without compromising the building fabric.

Dolan explains: "It's external [insulation] because there's a lot of cantilever and areas with no support. We were able to sit the steel on the width of the blockwork, and we could wrap the whole house in insulation. If it was all cavity it would have been impossible to deal with the cold bridging," he says.

"Airtightness was hard enough, too, due to the engineering design. We had to get the right tapes and membranes," says Dolan.

"I've been building the last 20 years. I was building a new house for myself about eight or nine years ago, in the middle of the recession, and while I was doing that I retrained myself."

At An Spidéal, the end result has pleased all parties, and GreenTec's expertise helped to ensure Túr Uisce was never going to be a *túr aer fuar**.

**tower of cold air.*

CONSTRUCTION IN PROGRESS











1 The triple glazed windows fitted proud of the blockwork to ensure a continuous thermal layer between insulation and glazing; **2** installation of the graphite-enhanced external EPS insulation; **3** Ampack Resano vapour control membrane and airtightness layer at the base of the roof build-up; **4** the Alkorsolar is a low weight system for fixing the array of 40 Joule solar vacuum tubes onto the flat roof; **5 & top** the client's Connemara marble hearth from their former home was modified and re-used in the new house.

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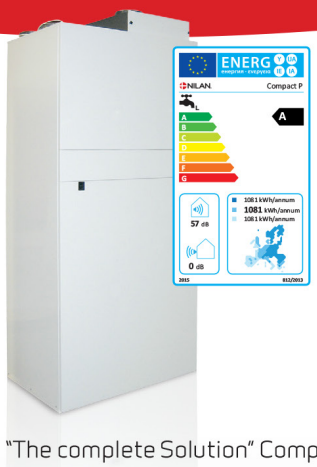
SELECTED PROJECT DETAILS

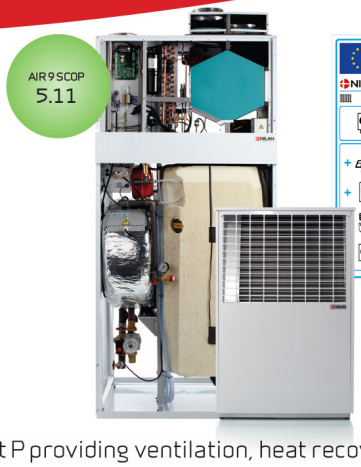
Client: Joe Folan
Architect: Helena McElmeel Architects
Main contractor: GreenTec Building
Mechanical engineering: Integrated Energy
Structural engineer: Peter Williams / Seamus Glacken Consulting Engineers
BER & airtightness test: 2eva.ie
Passive house consultancy & certification: Mosart
Mechanical contractor: Carrs EcoSolutions
Electrical contractor: Wattpower
MVHR: Brink HRV
MVHR installation: Airflow Ireland
External insulation system: Baumit
Thermal blocks: Quinn Building Products / Foamglas
Airtightness products & thermal breaks: Partel
Stove: Brunner, via EcoWBS
Solar thermal panels: Joule
Kitchen & fitted furniture: Galworx

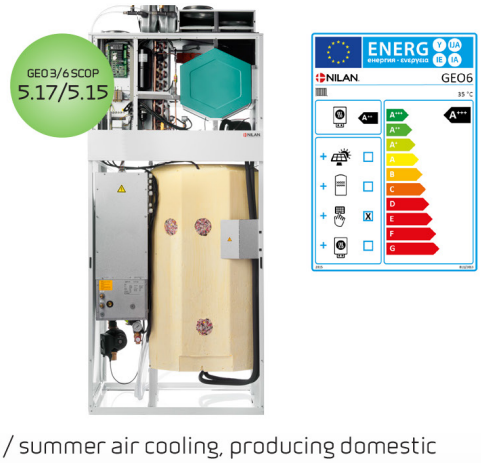
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IN DETAIL

Building type: Detached 180 sqm externally insulated concrete block house

Location: An Spidéal, County Galway

Completion date: November 2015

Budget: €310,000

Passive house certification: Pending

Space heating demand (state calculation tool, e.g. PHPP): 15 kWh/m²/yr

Heat load (state calculation tool, e.g. PHPP): 9 W/m²

Primary energy demand (state calculation tool, e.g. PHPP): 91 kWh/m²/yr

Heat loss form factor (state calculation tool, e.g. PHPP): Not available.

Overheating (state calculation tool, e.g. PHPP): 2% of year above 25C

BER: A2 (47.39 kWh/m²/yr)

Measured energy consumption: Not available

Airtightness: 0.51 ACH at 50 Pa or 0.52m³/m²/hr at 50 Pa

Thermal bridging: First course combination of Quinn Lite blocks and Perinsul HL thermal breaks, low thermal conductivity wall ties, thermally broken windows frames, 25mm Compacfoam to base of all floor-to-ceiling windows and doors.

Energy bills (measured or estimated): €250 per year (Joe Folan's estimated annual spend on timber for his wood burning stove).

Ground floor: 70% GGBS concrete raft foundation insulated with 150mm Quinntherm PIR insulation. U-value: 0.115 W/m²K

Walls: Baumit external wall insulation system comprising SilikonTop render finish, on 250mm / 270mm graphite expanded polystyrene boards, on 215mm concrete block-on-flat.
U-values 0.119 and 0.110 W/m²K

ROOFS
First floor: Renolit Alkorplan PVC roof membrane on 200mm Xtratherm flat roof board, on Alutrix vapour control membrane, on ply deck laid to fall over 225mm x 44mm joists, fully filled with Knauf Earthwool glass and rock mineral wool. Ampack Resano membrane to underside of joists with battened service cavity and wallboard finish.
U-value: 0.068 W/m²K

Zinc roof: VM Zinc Quartz on breather membrane, on 160mm Kingspan Metdeck board on vapour barrier, on ply, on 225mm x 44mm rafter with Ampack Resano vapour control and airtightness layer.
U value: 0.13 W/m²K

Windows: Triple glazed aluminium-clad timber windows, U-value: 0.80 W/m²K. 25mm Compacfoam thermal break to base of all floor-to-ceiling windows and doors.

Heating system: Brunner HKD 2.2kW SK water heating stove supplying domestic hot water and underfloor heating and 500 litre buffer tank, plus 40 Joule solar vacuum tubes on flat roof supported on Alkorsolar system.

Ventilation: Brink Renovent Excellent 400 heat recovery ventilation unit with semi-rigid ducting and manifolded air distribution system. Passive House Institute certified to have heat recovery rate of 84%.



The Tipperary Energy Agency team outside their office at Erasmus Smith House in Cahir.

TIPPERARY ENERGY AGENCY AT 20

INSIGHTS ON HOW TO KICK-START CLIMATE ACTION

One of Ireland's pioneering and most consequential green organisations, Tipperary Energy Agency, turned 20 at the end of February, evolving from one man buried in sawdust to a 24 strong team whose efforts are influencing national policy and earning European plaudits. But why has the agency endured and grown, and what lessons can be learned to help others play their part in delivering the transition we so urgently need to low energy buildings and clean energy generation? Two of the central figures in the agency's development spill the beans, along with some of the many partners the agency has worked with over the years.

Working with communities, chasing kilowatt hours

By Tipperary Energy Agency founder, Seamus Hoyne





(above left) SuperHomes participants Neil and Aileen Walker are thrilled with the comfort and enery savings at their A-rated retrofit in north Dublin; (above right) Tipperary Energy Agency founder Seamus Hoyne in the agency's rudimentary original offices in the late 90s.

Reflecting back on 20 years of the Tipperary Energy Agency presents an opportunity to reminisce on an amazing journey. From the outset the agency has been about partnership. Tipperary Institute and the then North and South Tipperary County Councils joined forces to apply to the highly successful EU SAVE programme to fund the development of the Agency (over 300 such Energy Agencies were established across Europe). At the same time that the TEA was being established a new agency was also set up in Larissa, Greece with both new agencies being mentored by the Styrian Energy Agency in Austria. I landed the job as the manager in February 1998 and was given a 300 page document (the EU proposal), a mobile phone, and directions to a small office over the then South Tipperary area offices in Cahir. There was a promise of an office space in the old VEC School building in Cahir which I was told needed "some work" (this turned out to be the woodwork room which still had a large saw and two significant piles of saw dust). From these humble beginnings the agency now occupies two offices in Cahir and Nenagh.

From an organisational perspective the vision from the agency from the outset was focused on partnership, sustainability and community engagement. However, without the agency being able to justify its existence and generate income for itself it was not going to be in a position to affect change in the region. With this in mind the first business plan was written in month one as I viewed the grant from the EU as a "bank loan" for the first three years.

Early on I visited the Styrian Energy Agency to gain their insights. Arriving in Graz in September 1998 I met the agency director, Mr Gerhard Ulz. During three intensive days of activity where I was exposed to a fantastic learning experience the biggest memory I have is Gerhard telling me on day one, "There are two important things you need to do to have a successful energy agency. First make sure you have refreshments in the office for your visitors (Gerhard had a special drinks cabinet) and second is find the crazy people". When pushed on the "crazy" people Gerhard meant that you needed to find those people who will go beyond the norm, who will challenge the status quo, who will ask the difficult questions. His advice was to put some of them on the board, get involved with them on projects and support them to reach their ambitions.

The board of the agency has changed over the years but the common feature has been vision and ambition. The board in the first three years guided the agency to a position where agreement was reached between Tipperary Institute and the councils to continue to fund it after the EU SAVE Contract. To put this in context, over 30% of all energy agencies funded under SAVE did not continue after their initial contract.

The early milestone came when I met with John Fogarty and others from the Templederry area of Co. Tipperary. John (who I now affectionately refer to as one of my crazy people) and his team had a vision to use the natural resources in their area to the best advantage of the community. The first meeting was in 1999. Over 10 years later the Templederry Community Wind Farm started generating electricity. This project is one of the many visual demonstrations of why local/regional energy agencies are needed. Without the agency many of the steps in the development process for the community group wouldn't have been achieved – but likewise without the community the agency would not have been able to deliver the project. We have managed to find lots more local and community-driven initiatives since.

When I sat down with Paul Kenny (now CEO) in 2006 when he joined the agency first, we looked through a pile of 15-20 energy audits of local authority sites. That day we made a decision to translate the words in those reports to actual kilowatt hours saved (or generated). The decisions at that point to move to a more action-orientated approach was, on reflection, momentous as it meant that we now had to work really hard on convincing people to invest, we had to get better at procurement and we had to maximise funding availability to support the business case for investment.

The final highlight which I'll select is the securing of the major EU contract under the CONCERTO programme to implement the SERVE project. Led by Tipperary Institute with partners in five EU Countries and involving an investment of €10.4m, this funding allowed Tipperary Energy Agency to scale and hire new staff. It enabled it to develop real expertise in retrofitting of buildings, heat energy contracts and many other aspects. It also provided a financial buffer to maintain the agency during the challenging financial crises.

The agency has been extremely fortunate to recruit the right people at the right time during the different phases of its growth. Like any organisation people have come and gone, but the one characteristic which they have all shared is their commitment to the cause of sustainable energy and climate change. Many late nights have been spent writing proposals and completing tasks. Many cups of tea in meetings, with everyone from homeowners to politicians, convincing, confirming, and cajoling people to take the right decisions. From students on work experience to long term employees, they have all left their mark on the agency and made it is what it is today. The vision for the future is safe in their hands as we now have over 20 of our own crazy people to get things done!

It's about challenging the status quo, & fighting fossil fuels

By Tipperary Energy Agency CEO Paul Kenny





(left) Tipperary Energy Agency CEO Paul Kenny; (right) SuperHomes participant Aileen McCarthy, who suffers from respiratory problems, says her health has been transformed post retrofit.

In December 2006 I joined the energy agency from a large multinational, inspired by the desire to spend more time engineering and make a difference. I had completed a certificate in renewable energy development in Tipperary Institute and was eager to get involved. It's something that we look for in all staff when we recruit: someone who has a desire to make a difference, someone who doesn't accept the status quo, someone who doesn't accept that fossil fuels should be part of our future.

When I started I was introduced to a very different culture of work, a culture of trying to make a difference, a culture of being introduced to the deep end and most importantly a culture where there was no fear of failure. If something went wrong, it was always a case of we'll do better together the next time. This no fear of failure is one of the key reasons why the agency has delivered innovation, change and some influential projects. This culture of attempting to do things that we weren't sure we could deliver made, and still makes, Tipperary Energy Agency such a brilliant place to work.

The agency participated in over 30 EU projects, which allowed us to see and touch the types of things that are needed to make the energy transition happen – from district heating in Scandinavia, to biomass boilers in Austria, to the citizen-led energy transition in Germany. This European education has been a bedrock of the agency's perceived innovations. We have built on this to deliver significant large projects of national importance, to help break the ice on PV, on biomass boilers and on heat pumps, and most importantly making the energy transition a little more mainstream. Today, with support from the European Investment Bank's ELENA programme, we have the ability to really ratchet up the investment at home with European help for developing sustainable energy investments across most sectors of the Tipperary economy.

Over the last five years, we have realised that specifying works on a design-build basis was at its limit and wasn't delivering the standards of works that our clients wanted. It was appropriate for simple works, insulation and shallow retrofit domestic sector. We realised that asking for challenging innovative technical solutions from the contracting sector was not going to deliver the potential that the technology could achieve. So from late 2015, we've grown our design office to include residential and non-residential capabilities to provide a full end-to-end service – a one-stop-shop development where our staff can do an energy audit, design a retrofit, apply for grant support, procure, project manage, and sign off the investment.

People who wish to embark on the energy transition, make their home warmer, or their business more efficient need support. The technical engineering solutions aren't easy, and people need the technical help to deliver high quality projects. There is a second task that we now do, and that is the sales pitch for the energy transition. It isn't overt, but it's there. We don't want people to complete an energy audit and leave it on a shelf, we want people to decide to invest and reduce costs, CO_2 and fossil fuel use. Our team always feel that the goal of an energy audit is investment, never just identifying a potential solution.

We developed the Superhomes Deep retrofit programme to support homeowners to move away from cold damp homes heated by fossil fuels. It originally came from the challenge in meeting the decarbonisation targets for Irish homes and simultaneously making them warmer, healthier and cheaper to run. We were being told that heat pumps wouldn't work in Ireland, and that ventilation through holes in walls was fine (even though we knew it wasn't). We researched solutions and presented a pilot proposal to our national energy agency, who funded homeowners to upgrade their homes for the last three years.

The next 20 years will require every building to be retrofitted, every citizen to become an active energy citizen and every organisation to decide to move away from fossil fuels. In order to achieve this goal, we will need to have accessible technical solutions but also accessible financial solutions that mixes grant supports, low-cost finance, carbon taxes and the confidence for people to be able to use these solutions. That's our goal – to figure out these solutions, to try and fail and try again until we have the solutions to scale the energy transition, until it's available easily for every citizen and organisation.

RICHARD SHERLOCK
National sales manager, Mitsubishi Electric

Mitsubishi Electric have been strong supporters of the Tipperary Energy Agency Superhomes scheme since its inception. This is a highly important program offering householders a high quality holistic retrofit package which always includes an air source heat pump at the centre of its offering. The program is very important for Mitsubishi Electric and our commitment to the Irish market in terms of demonstrating, publishing and proving the real-life performance of heat pumps in retrofitted Irish houses of all types. The research being conducted at multiple levels – up to PhD – will assist in the sustainable growth of the heat pump sector and assist in no small way in meeting Ireland's energy saving obligations.

Mitsubishi Electric have supplied the vast majority of heat pumps on the Superhomes schemes to date and we have taken the opportunity to use Ireland as a European research base. There is regular interaction with our European research teams which will help form the base for the next generation of heat pumps we design and manufacture. Conjoined with this research we are also exploring the funding of a PhD researcher in this area with NUIG, which we at Mitsubishi Electric feel further demonstrates our commitment to the Irish market, following 35 years in business in Ireland.

Superhomes is critical to the development of a high quality retrofit offering in the market and in the proving that heat pumps are the way forward in all Irish housing. I hope the results will be listened to and acted upon by policy makers.

SIMON JONES
Commercial director UK & Ireland, Aereco

Ventilation and retrofit sometimes feel a little like oil and water. The retrofit sector as an industry has struggled at times to deal effectively with the concept and we are already paying the price in some cases.

Tipperary Energy Agency should be credited as one of the early adopters of the concept of designed ventilation strategies for retrofit, and their robust stance on no effective ventilation, no retrofit, is a credit to them. (Specifically this means a fan-driven ventilation system set up to reliably achieve a predictable, acceptable number of air changes).

They have shown the way and many, including state-funded schemes are now following - something I am not convinced would have happened without them.

Their end-to-end approach has driven the take-up of the Superhomes scheme, but their approach to quality assurance has also played a very big part. How many successive retrofits are as a result of the positive feedback from previous participants of the scheme? If any scheme going forward is to succeed and build to the scale necessary, there's a lot to learn from Tipperary Energy Agency's approach to quality assurance on the supply chain and the delivery of retrofit projects.



Some of the projects supported by the agency over the years including Templederry Community Wind Farm (left) and the 45kW solar PV array on the roof of the Tipperary County Council building in Nenagh (seen here with council CEO Joe McGrath)

Sustainable Tipp – action plan for major CO_2 cuts by 2020

Recognising the need for immediate and short term cuts in carbon emissions – given the climate change tipping point the world faces – Tipperary Energy Agency has developed Sustainable Tipp, an action plan to deliver energy transformation of Tipperary's housing, commercial, public and community buildings over three years. It is an opportunity for communities, farmers, homeowners and business owners to save energy, save money and become more sustainable.

In 2017 Tipperary's Sustainable Energy Action Plan (SEAP) was formally adopted by Tipperary County Council. This plan was created following Tipperary's commitment to The Covenant of Mayors, the world's largest movement for local climate and energy actions. This plan explains the steps that need to be taken to reduce Tipperary's CO_2 emissions by 30% by 2020.

That same year, Tipperary Energy Agency, announced that the European Investment Bank (EIB) is to support the actions of the SEAP. This action plan includes 32 actions which will reduce Tipperary's energy related CO_2 emissions by 2020. These actions cover a wide range of sectors including agriculture, education, planning, residential, local authority and the commercial sector.

Following the approval of the SEAP for County Tipperary and the support from the European Investment Bank, Sustainable Tipp was born. Sustainable Tipp will endeavour to keep Tipperary citizens up to date on the actions and progress of the SEAP, as there are opportunities for everyone in Tipperary.

The main objectives of Sustainable Tipp are:

- To promote and encourage greater energy efficiency in Tipperary
- To reduce Tipperary's dependency on imported energy by encouraging renewable developments
- To create employment through the deployment of renewable infrastructure and widespread energy efficiency upgrades
- To reduce energy poverty
- To ensure that small and medium sized businesses are made aware of the financial rewards associated with increased energy efficiency
- To raise awareness of Tipperary's obligations and opportunities in renewable energy and energy efficiency
- To foster the opportunities in energy efficiency and production in the agricultural sector
- To facilitate greater capacity building within all associated institutions. ■

PAUL O'BRIEN, SOLA

We first worked with Tipperary Energy Agency on the Serve Project in 2009-2010 – retrofitting solar thermal on existing houses in North Tipperary. In 2012 we fitted two air source heat pumps for the agency in an outdoor swimming pool in Ballina, in North Tipperary, which is open from June to September. They've been hugely successful – running costs of about €30 per day. In another early project with them we fitted PV arrays on nine public buildings. The council saved €30,000 in the first year.

We worked hand-in-hand with Paul Kenny on some of the first jobs – he was out getting his hands dirty commissioning heat pumps to get the COPs to where they should be.

The way the Superhomes grants materialised, you had to be doing a combined fabric upgrade. Their knowledge and the way they manage the design process gave us the confidence to start acting as main contractor, and subbing in the insulation works to specialist subcontractors. It's broadened our spectrum of work, and we're now able to act as a main contractor on retrofits and extensions.

We have peace of mind if Tipperary Energy Agency spec out a house – we know the heating system won't be undersized. They do an itemised bill of quantities. If the house is done to the spec they provide there's no issue with the heat pump performing. They do all the heat load calculations room by room. They have a good team.

We love the challenge of deep retrofit. People are living in the house before we start and they can see the transformation afterwards. Working with the agency gave us the confidence that we could branch into other areas. Only for them, we wouldn't be where we are today.

The PH+ guide to INSULATING CONCRETE FORMWORK

As demand for super-insulated and airtight building structures grows, insulating concrete formwork (ICF) is rapidly gaining popularity as a method of construction. But what exactly is ICF, what are its key advantages, and why is it so well suited to passive house and low energy construction?

Words by John Cradden





Insulated concrete formwork involves a structural shell of insulation, usually polystyrene, into which concrete is then poured. Seen here are systems from Econekt (left) and Integraspec (right) under construction.

Insulated concrete formwork is a method of building construction using lightweight and hollow insulation forms that fit together and are then filled with concrete. Once set, the concrete becomes a high-strength structure and the formwork remains in place as thermal insulation.

It's actually been around since the 1970s in some countries, but in the intervening decades it has largely remained a niche choice, perhaps suffering from conservative tendencies in a sector reluctant to move away from traditional cavity wall construction, and from regulations which have placed little emphasis on superinsulation, airtightness and thermal bridging. ICF has tended to be the preserve of customers who want a high-quality construction with low running costs and aren't just thinking about building as cheaply as possible.

But, of course, thanks to the demand for greater new-build energy efficiency, ICF has come much more into focus within the construction industry in recent years, including in the passive house sector. This is because by definition it offers excellent insulation and airtightness performance. There are several suppliers now established in Ireland and the UK.

Pros

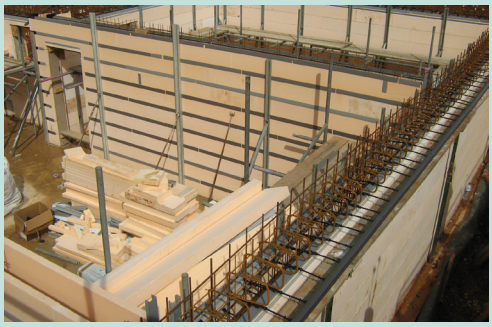
ICF is certainly finding its advocates among energy-conscious architects and designers thanks to certain advantages that enhance its thermal performance, including inherent airtightness, the virtual elimination of thermal bridging and the fact that its advertised U-values are reliably achieved. There's a simple logic behind this: when the insulation is serving as formwork for a concrete pour, the insulation has to be unbroken, or the formwork simply won't hold the concrete. But it's not just the presence of the insulation: it's the fact that the concrete sets in direct contact with the insulation, and therefore delivers both airtightness and prevents thermal looping from undermining insulation performance.

The significance of this can't be overstated. Studies have shown that gaps in insulation can dramatically undermine U-values. Insulation testing of a cavity wall with 50mm of XPS insulation in the cavity – with a 10mm gap to the inner leaf and 40mm gap to the outer leaf – showed that a 3mm gap between the insulation boards increased the U-value from 0.34 to 0.54 W/m^2K, whereas a 10mm gap increased it to 0.65 W/m^2K, as the thermal performance was undermined by natural convection.

In contacting most of the ICF suppliers in the Irish and UK markets for this article, it became quickly apparent that most companies were able to reel off projects showing remarkably low heating costs, even in some instances in spite of relatively modest U-values — as the mini case studies alongside this guide demonstrate.

Thermal bridging guru Andrew Lundberg of Passivate says that passive house designers are





ICF systems under construction from (left to right) Amvix, Logix and Polarwall.

generally agnostic when it comes to construction types because the focus is primarily on energy conservation, but says that ICF performs particularly well for passive house applications because insulation continuity is guaranteed at all standard junctions, and at good thicknesses.

"Some system suppliers have also taken the positive step in having catalogues of standard details and related psi values and fRsi values developed for their systems as part of their Agrément cert applications, and that offers them currently a unique or rarely seen selling point, as well as demonstrating the performance of their systems and removing any guesswork. That also saves significant cost for people looking to build with those systems."

Skills

ICF is a very different method from traditional masonry construction, with some saying the skill set required is more akin to carpentry than blocklaying. There may not be many experienced ICF builders around, but it may be inevitable that more builders incorporate the method into their skillsets given the combination of quick build speed and high performance it offers, in a market where energy performance standards are rising exponentially.

While the UK market has been served by an Insulation Concrete Formwork Association since 1992, in Ireland it's another matter. The Irish Concrete Federation is in the throes of setting up a separate body within its organisation to better represent the views of the burgeoning ICF industry in Ireland, and to promote standards as well as selling its benefits. Part of this plan will include devising training and upskilling programmes for its members, according to its CEO, Gerry Farrell.

Raw materials

While ICF certainly has its advocates, others may baulk at the fact that it typically comprises two materials which can have comparatively high environmental impacts: ready-mixed concrete and polystyrene. Both materials have relatively high embodied carbon emissions, although the question of how green ICF is may need to be based on a systematic sustainability assessment of the whole construction. Such an assessment could determine the embodied CO_2 of a material, among other parameters, including a full life cycle analysis.

In its favour, ICF starts with the advantage of comprising fewer materials than other construction types, and there are various suppliers of both concrete and EPS who are manufacturing using recycled materials, including GGBS (ground granulated blast-furnace slag), a low carbon "green" cement derived from recycled steel industry waste.

Then there's recyclability. The materials typically used to manufacture ICF – EPS, concrete, plastic ties and steel rebar – typically lend themselves to recycling once the building reaches its end of life, which was a significant factor in Irish firm Amvic gaining a BRE Green Guide rating of A+ on its system.

It's also important to compare like with like. While an ICF wall contains a relatively large amount of (typically polystyrene) insulation, a fair comparison would have to include other wall types achieving the same performance – which in terms of traditional construction, for instance, would involve similar quantities of insulation, plus thermal breaks and the materials to construct inner and outer leafs.

The vast majority of construction projects use significant elements of synthetic insulations which are oil-based or derivatives.

Velox is one ICF manufacturer that normally eschews EPS in favour of a structural wood/cement, but also offers versions with EPS or platimum EPS.

Polarwall uses exclusively XPS (extruded polystyrene), which it says has a better thermal performance than EPS and therefore reduces the overall wall thickness, helping to increase the internal living area.

North American manufacturer Nudura's system offers credits under the USGBC's LEED environmental rating system, scoring highly for energy performance, while also offering credits for its use of 100% recycled polypropylene and steel folding webs, which the company says enables the cavity in the formwork to be closed during transportation, enabling up to 40% more material to be transported.





(left) Velox's unusual spin on ICF, in this case with additional platinum EPS insulation fixed to the structural wood/cement formwork; (middle) the Polycrete ICF system – in another example of ICF being used below ground level; (right) the Nudura ICF system going up like Lego.

Ultimately, if your main sustainability focus is energy consumption in use, then there is a wide range of construction types, including ICF, that would be perfectly suitable for low-energy, nZEB and passive house projects. "If your main concern is sustainability, embodied energy and CO_2, then you're into a much narrower range of product which unfortunately comes at a price premium that the mass market aren't currently interested in paying," says Lundberg.

Compatibility

In terms of the compatibility of ICF construction with a variety of other building methods, a number of suppliers we spoke to say that there are no issues with using ICF in combination with strip or other insulated foundations.

"ICF works perfectly with any foundation system – be it strip, concrete raft or insulated raft, they provide no problems. Even in basements there is no problem as long as the tanking of raft and walls are properly addressed," says Dony Kelly of Thermohouse.

ICF is also proving a solid option for hybrid constructions where it forms the basis for the ground floor – or basement – with a different structure on the top, such as timber frame. But it can also be used for buildings that go as high as 20 storeys, although some systems may have lower limits depending on a variety of factors.

Fire

Concrete is among the best performing materials in the event of fire, meaning the concrete structure of ICF lends the system inherent fire safety advantages. ICF systems typically offer between two and four hours of fire resistance, with greater resistance achieved by walls with wider concrete cores.

Meanwhile manufacturers point out that the insulation used in ICF is manufactured with flame retardant additives. ICF is also typically finished with cementitious renders externally – though a broad range of finishes are possible, including brick and stone slips from specialist suppliers such as Monolith, and rainscreen cladding – and plasterboard internally.

It's understood that some multi-storey ICF constructions on the continent have been built with no firebreaks. Although this may raise some concerns for high rise applications given the scrutiny being applied to different construction approaches in response to the Grenfell tower disaster, the fire performance of an external insulation layer fully encased behind a cementitious render system can't be compared to a ventilated rainscreen cladding system – let alone one with a polyethylene core.

It's also reassuring to know that most suppliers will happily engineer firebreaks in, horizontally between each floor and vertically within the exterior insulation. Dony Kelly of Thermohouse says it is crucial that firebreaks must be in contact with the concrete core, so the EPS must be removed before the firebreak is installed. Velox, however, says that there is no need for separate firebreaks with its system because the formwork is made out of fire resistant material, but can fit them if required.

In terms of size, ICF walls range in thickness from 120mm (the absolute minimum permitted by the Eurocode standards) to 300mm. In a nutshell, a standard wall will

ICF and thermal mass

Suppliers and advocates also point to the benefit of a long 'decrement delay' with ICF — i.e. that it can slow temperature changes by absorbing and releasing heat slowly — because its concrete core offers high thermal mass.

The benefit of having a high thermal mass is that it can moderate internal temperatures and delay the time at which peak temperatures occur. In practical terms, the theory goes that this means that the building should have lower winter heating requirements, along with a lower risk of overheating and less demand for air conditioning in summer.

However, there are still some grey areas in terms of the understanding of thermal mass in general, and in the thermal mass properties of systems such as ICF, with some research that ICF's thermal mass is high, and some suggesting it is relatively low.

But even if the thermal mass of ICF is low, it may not be a bad thing. In low energy buildings, both thermally massive and lightweight structures can be prone to overheating. If too much heat is allowed to accumulate into thermally massive materials, they may simply take too long to cool down.

But the thermal mass effects of ICF – like many other construction methods – depends on its exact configuration, including what materials are used internally and externally. The local climate is another factor, too.

The conventional wisdom is that thermal mass needs to be exposed to have an impact, which is why the likes of exposed concrete slabs have long been a common feature as a passive cooling strategy in office buildings. This effect is undermined somewhat if you apply plaster or plasterboard, and possibly even more so if insulation is placed between the room and the wall's concrete structure.

When it comes to ICF, you will typically have a mix of very high-density concrete with very low-density expanded polystyrene. "When low heat capacity materials [like polystyrene] are exposed to heat sources, whether it's solar gain or internal heat sources, you will get a relatively significant increase in temperature in those materials for relatively little heat input," says Andy Lundberg of Passivate.

So from a cool state, an ICF home will have a relatively rapid response time to indoor heating, compared to exposed heavyweight structures. This also means that solar gain on the external facade can heat up the outer EPS layer quite significantly — but the effect of this on the internal environment is diluted by the heavy thermal mass of the concrete core.

In solid constructions without cavities this balance can be very important in maintaining comfortable environments, Lundberg says. But these effects can be significantly altered by internal liners, eg skimmed & painted plasterboard on a service cavity, and external render systems, which can feature dark absorbent colours or highly reflective finishes.

"We are now at a point where each project should be examined in isolation to ensure that the wall build-ups, including external and internal finishes, work for the specific building in its location and environment. We have the knowledge to do this, and not an excuse in sight not to."

"However, once these inner and outer layers are covered by either external renders, or ventilated cladding systems, or have an internal service cavity installed or even just plasterboard fixed directly to the system, everything changes," says Lundberg, adding that this is equally true for a cavity wall construction.

"So the key point is, there is no right or wrong when it comes to thermal mass and what's exposed and what's not. Every building is different and will perform differently."

So figuring out the best solution for each project would require focusing not just on calculating heat losses using steady-state U-values and looking at the overheating risk if needed, but also at the best use of thermal mass effects – including decrement delay – in order to bring out the best in the materials. Lundberg says: "On some projects that may involve exposing thermal mass, and on others may require burying it behind lighter materials. It all depends on what the specific project needs.

"It's the next step in trying to model buildings more accurately for the as-built condition, but we're just not there yet."

typically be 150mm thick, but 200mm or more is better to combat the shear forces, building loadings and wind forces associated with taller buildings.

Speed of construction

One of the advantages of ICF over block-building and other methods – as long as experienced builders are involved – is the speed of construction. A typical house can be built at a rate of a single storey per week. Velox's benchmark is eight working days with three men to build a two-storey 42 sqm detached council house from slab to wall plate, all concreted.

Naturally, others say that speed depends on a number of factors. Serge Mellieur, who heads Canadian ICF supplier Polycrete, said: "Normally if you have a good working team and good planning, our construction system is faster than anything else, because we cover the structure and the insulation at the same time with the same team of workers. But never forget that quality of construction has to be your first goal before speed."

There are no reported issues with interstitial condensation which, given the claims for ICF regarding the elimination of thermal bridging, is as it should be. The key factors here include good airtightness, mechanical ventilation, and having the correct balance of insulation so that the dew point is kept towards the outside of the structure.

Three year old passive house, Dunmore East, Co. Waterford









Featured in a case study in Passive House Plus not long after it was completed in 2015, quantity surveyor John Carney's passive house on the windswept but sunny Waterford coast has now been occupied for almost three years. According to Carney, the house – built using the Amvic ICF system – has been working a treat. "The beautiful thing of this house is that every part of it is comfortable," he says.

Placing faith in the fabric first-based design's ability to reduce the need for active heating in spite of its exposed location, Carney opted to reduce capital expenditure on a heating system by going all electric. The only active space heating input comes from direct electric heating, including electric underfloor heating in the main living area, and electric fires in the kitchen and living room – seldom-used, as they quickly cause the rooms to overheat – in addition to electric heaters in some rooms, including bedrooms. "We've never used the heaters in the bedrooms," he says. "It does require heat though." When Passive House Plus previously covered the house, the plan was to use one electric storage heater on night rate electricity as the main heat source for the 245 sqm house. "It was giving too much heat in the morning when we didn't need it and not enough when we did, so we put in a Dimplex programmable heater instead."

The performance has been impressive. PHPP calculations predicted a primary energy total of 104 kWh/m^2/yr for all energy use – including everything from the energy to run the electric gates, outside lights, septic tank and appliances. The actual use has averaged 84 kWh/m^2/yr.

The house is home to empty nesters Carney and his wife Bridget, along with occasional guests. "We have returning fledglings – with their extra fledglings from time to time," says Carney, whose Berlin-based son and New Jersey-based daughter and their respective broods added six occupants when Passive House Plus made contact for this piece. "They were visiting friends locally. When they came home to the passive house, they noticed the comfort – even though the other houses had stoves, and we have none."

The Amvic system helped Carney – who recently retired from lecturing at Waterford Institute of Technology but still works as a quantity surveyor and project manager – to avoid thermal bridges and achieve high levels of airtightness, with the help of a Siga airtightness membrane and tapes. The house scored an impressive test result of 0.33 ACH at 50 Pa, though Carney notes issues with an external door warping would likely mean more leakage if the building was retested. 100mm of Neopor insulation was added externally to drop the total wall U-value to 0.13 W/m^2K.

The Carneys own two other homes on the land – a small thatched cottage that served as the original family home, a passive solar-designed house built by Carney, and the new passive house – and all three are being monitored for temperature and relative humidity, with the cottage and 1990 house seeing large swings in temperature and humidity. "The passive house is much more stable" he says.













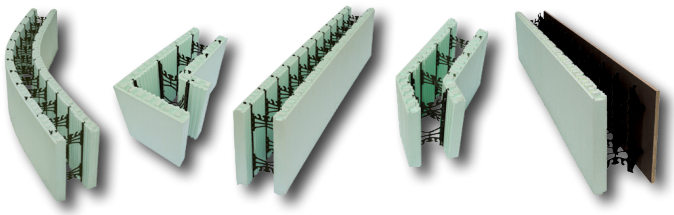
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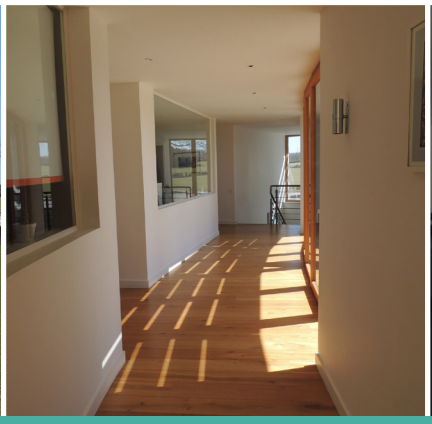
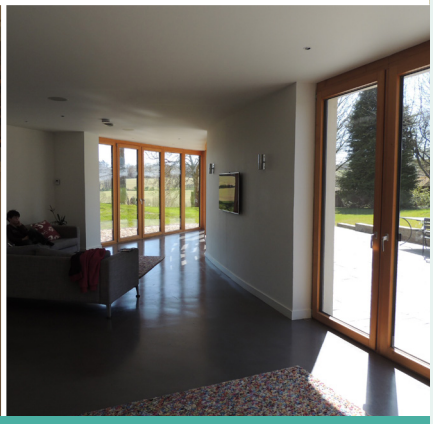
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The Curly House, West Sussex





Built on a particularly exposed site near Chichester where winter temperatures plummet all too frequently – down as low as minus sixteen – the award-winning Curly House had to overcome several challenges. Sited in an Area of Outstanding Natural Beauty in a National Park and with all of the planning restrictions that brings, the clients wanted a contemporary design and a particularly warm house – perhaps a response to the bone-shakingly cold, poorly extended cottage that previously sat on the site.

And the resultant house – named The Curly House in reference to the local vernacular of sweeping flintwork walls, and with a flint-clad curved façade to the rear – is an exceptional example of how low energy architecture does not necessarily equate to design limitations or 'inside of the box' thinking.

The clients wanted the 421 sqm home to have year-round comfort with minimal reliance on fossil fuels and the national grid. Architects Ecotecture produced a crescent-shaped design to enable the house to track the winter sun, but with a large expanse of brise soleil to ensure that winter cosiness wasn't achieved at the expense of suffering in the summer heat. The design responds cleverly to the sloping site, chiefly in single storey, form but with a lower storey section to the east cut into the site.

Taking all of these challenges on board – and the need to minimise air leakage and thermal bridging for the project's passive house-inspired approach – the Nudura insulating concrete formwork system was selected, combined with the Op-Deck insulated concrete flooring system. Passive house-certified Optiwin windows were also chosen for their high performance, while the house, built by Kithurst Builders – is ventilated efficiently and effectively by a heat recovery ventilation system from Green Building Store.

Pre-completion airtightness testing showed that the recipe had worked extremely well: the house scored 0.20 ACH @ 50 Pa – three times lower than the stringent passive house requirement, and the lowest result an Ecotecture project had ever achieved, in spite of the complexity of the design. According to Nudura and Ecotecture, all other construction methods considered for this design would have thermal bridging and bypass issues local to the shading devices. Nudura's ICF system eliminated these issues and was key to the radical design's success.

Energy monitoring was conducted of the completed dwelling in the first year post-occupancy, and shows that the final energy use for space heating and hot water totalled under 30 kWh/m²/yr, a figure that would have been closer to 35 without the solar thermal array. That figure looks good at first glance, but it looks even better if you consider it's for a house that the homeowners keep ticking over at 24C all winter.

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Can you name:-

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A build system that is fast to build?
A system that is so simple to design and without any modularity?
A system that is so simple it is used by self-builders?
A system that can create any curve (radius or even freehand)?
A system that can be built in all weathers – without delays?
A system that can incorporate the highest security (including bombproof)?
A system that can create basements and earth sheltered homes?
A system that ties in with any other type of roofs, floors etc?

and finally...

A building system that can meet all previous 9 questions?

(hint – the answer is written below)

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Ultra low energy house, Somerset









When Roger Yeoman turned the heating on in his ultra-low energy ICF house in January of this year, it was the first time he'd done so since moving in four years ago. "The beast from the east defeated our eco house," he says. "Four years after completing the house we turned the heating on for the first time."

Yeoman explains that four days of freezing temperatures and no solar gain had seen the temperature inside his Somerset home drop to 19C. Turning on the underfloor electric heating for just three hours was enough to bring it back up to 20.5C.

Yeoman's house was constructed with an ICF system from leading international ICF specialist Logix, with walls featuring 203mm of graphite-enhanced EPS foam externally and 70mm of the same material internally, sandwiching a concrete core. There's a polymer render on the walls externally, and cedar cladding on the upper floor too.

"Roger took the simple approach of facing the house south and achieving a U-value of 0.11 W/m2k for all solid elements," says Jonathan Barnett of Logix. "It meets the passive house airtightness requirements without tape or membranes except at windows, thanks to the Logix wall being an effective barrier." Barnett estimates that the house has consumed just 362 watts of active heating over four years — or just 9 watts per square metre.

The house also features a Unilin roofing system and Isoquick passive insulated foundation system, with all the opaque building elements delivering a U-value of 0.11 W/m2K or better.

It also has electric underfloor heating, a small electric fire in the lounge, a solar thermal hot water system and a 3kW immersion, plus a 4kWp solar PV array.

Yeoman elaborates on his experience of heating the house so far. "The winter 2014-2015, we did not switch on the electric underfloor heating at all. We did need a blast from the electric fire in the lounge when we first used it in the evenings, because 19.5C feels cold when compared to the rest of the house."

"The lounge is closed all day and unoccupied," he explains. "If there has been winter sun the room will rise to 25C and be comfortable by evening without the 15 minute blast from the electric heater."

Taking 2015 as a sample year, the couple spent £838 in total on electricity, but received a £758 feed-in tariff for exporting 4,4402 kWh of solar power to the grid, leaving them with a net annual energy bill of just £80.

The house previously picked up the award for best eco home at the 2014 Build It Awards.

Next issue...

The PH+ guide to:

Foundations

What's the difference between different types of foundations, how should they be insulated, and what systems on the market work best for passive houses? Our next guide will look at designing and building super-insulated foundation systems that are free of thermal bridges, and ideally suited to passive and low energy dwellings.

Marketplace

Fresh-r wins passive house component award



(inset) Passive House Institute founder Dr Wolfgang Feist gives the component award to Fresh-r marketing director Edward Hissink and lead engineer Hans Arentsen.

The Dutch company Fresh-r has won the passive house components award at the 22nd annual Passive House Exhibition in Munich, for its decentralised residential ventilation system. Fresh-r worked together with the Scottish firm Collective Architecture on its submission for the award, which was presented at this year's international Passive House Conference.

"Two years ago, Fresh-r won the second prize, in the category for energy retrofits. Then it was a novelty, with a very narrow yet powerful heat exchanger that fits in the outer wall. Now it won the first prize, in the category new residential building. Because we think this should be the norm for layered construction," Dr. Wolfgang Feist of the Passive House Institute said in handing over the prize.

The award jury found the collective submission by the two companies "the most effective way of ventilating with heat recovery, where comfort is assured at the lowest price, without wasting energy," a statement from Fresh-r read.

It continued: "Fresh-r is like a breathing window. It is the smallest, simplest, smartest and most energy efficient ventilation with heat recovery. Because it uses copper to transfer the heat from one air stream to another. As a result, much wider air flows are possible, so that there is no pressure drop in the heat exchanger. Therefore, less power is needed. Less space. Less noise."

Edward Hissink of Fresh-r commented: "To take the stage at an exhibition where the world's pioneers in energy neutral construction are all together, to receive the first prize, feels great."

Fresh-r shared first place at the awards with ventilation manufacturer Pluggit. ■

Ecological launch range of new airtightness products

Ecological Building Systems have announced the launch of the new pro clima products Tescon Sprimer, Aerosana Viscon and Roflex Solido to the Irish and UK Markets. These new airtightness solutions "expand pro clima's market leading range of high quality sealing systems for inside and out".

Tescon Sprimer is a sprayable primer for wood, wood-fibre boards, masonry, roofs, walls and ground slabs. After the primer has been spray-applied, pro clima adhesive tapes such as Tescon Vana, Contega Solido and the Extoseal range can then be applied. Tescon Sprimer is easy to apply and saves installers precious time on site, according to pro clima. It also secures bonds, penetrates deep, and strengthens dusty substrates or surfaces with insufficient load-bearing capacity.

Aerosana Viscon, meanwhile, is a sprayable or paintable airtightness sealant with a humidity-variable vapour resistance. Viscon is a high quality, water-based acrylic dispersion paste which can be applied as a spray or using a brush. The sprayed-on liquid film forms a seamless, elastic airtight and vapour-resisting protective layer once it has dried. It can be plastered or painted over, used for strengthening subsurfaces in the case of renovation, and is suitable for use indoors or in protected outdoor areas.

Roflex Solido is a plasterable airtightness EPDM grommet that features full contact solid acrylic adhesive. Pipe penetrations through masonry walls often lead to considerable air leakage, but Roflex Solido can be bonded directly to masonry walls and is suitable for internal or internal applications. Even when pipes are pushed or pulled at a later stage, an airtight and weathertight seal is still retained.

For more information regarding the products mentioned above visit **www.ecologicalbuildingsystems.com.** ■



(above) Tescon Sprimer, Aerosana Viscon and Roflex Solido have been introduced into Ireland and the UK via Ecological Building Systems.



Ecocem managing director Micheál McKittrick alongside the company's new logo.

Ecocem rebrand with new logo and slogan

Ecocem, Europe's largest independent specialist producer of key low carbon building material GGBS (ground granulated blast-furnace slag) cement, has announced a re-brand with the launch of a new logo and tagline.

A statement from the company, which has a capacity of 2.4 million tonnes, read: "Significant developments in the organisation have seen a growing interaction across its operating regions in Ireland, Holland, France, the UK and Sweden, as well as the emergence of new product opportunities following three to four years of innovation work. In order to capture this change, Ecocem is rebranding across the group."

Ecocem Ireland operates a purpose built manufacturing facility in Dublin Port from which it services the bulk market in Ireland and the 25kg bag market in Ireland/UK.

The company's statement continued: "At the heart of the Ecocem brand is the concept of high quality and precision. The monogram of the letters "eco" come together in the company's new logo, representing the various stages of a project and underscoring the company's focus on innovation and sustainability, giving rise to the tagline – Innovation Powering Sustainability."

The company said that new product innovation opportunities will target areas as diverse as readymix, dry silo mortars, tile adhesives, screed, shotcrete, precast, roof tiles, piling and soil stabilisation. Many of these opportunities will be in areas that perhaps have not traditionally seen the benefits and usage of GGBS heretofore.

Micheál McKittrick, Ecocem Ireland's managing director commented: "The rebrand of Ecocem Ireland heralds an exciting period ahead where we will bring targeted product solutions to customers across Ireland and the UK." ■

Brink launches new MVHR unit with range of features



Leading mechanical ventilation with heat recovery (MVHR) manufacturer Brink Climate Systems has launched a new high efficiency MVHR unit, the Flair 325. According to the Dutch company, the new range comes with some exciting new technologies to boost efficiency, ensure correct ventilation rates and enable easy operation.

The new unit includes highly efficient EC constant-flow fans, fitted with rotating vane anemometers; TFT colour touch-screen for easy programming; 100% bypass of the heat exchanger when in summer bypass mode; guided vanes for equal airflow over the whole heat exchanger; a new condensate connection, with special ball syphon included; and a pre-heater with a larger surface and new aerodynamic design.

Brink has used constant flow fans in MVHR units since 1990, employing software that monitors changes to airflow in a system. This adjusts the fan speeds accordingly, ensuring that the dwelling is ventilated at the correct rate, with the fans working at optimum efficiency and airflows equally balanced.

The unique design of the constant flow fans in the Flair 325 MVHR unit have been manufactured to Brink's specifications and provide an even more accurate control of the airflow. This is achieved using an anemometer fitted to the discharge tube of each fan that enables a fast and very precise response to airflow requirements. The integrated digital programmer enables a system to be commissioned easily with balanced airflows (as an unbalanced system can swiftly loose thermal efficiency and cause pressure differences between the internal and external environments).

The Brink Flair 325 includes a redesigned heat exchanger with vanes guiding the airflow over the whole surface area of the heat exchanger. This design feature provides a laminar airflow to the heat exchanger, giving an even distribution of air through the heat exchanger for higher thermal efficiency and lower pressure loss (Pa).

The Brink Flair 325 is currently undergoing testing at a number of European institutes including the BRE and Passive House Institute - initial reports indicate market-leading results.

Brink products are available from CVC Direct in the UK. ■

(above) A close-up of a flow fan from the Brink Flair 325 MVHR unit.

Etude combines with Cocreate for improved passive house services

Etude, engineers specialising in sustainability, are combining with Cocreate passive house certification services. As a result, Etude will provide passive house certification as well as sustainability consultancy and passive house design from its office in London.

The tie-up will mean additional resources and a simpler, improved service for clients looking to certify their building to the passive house standard. It is accompanied by the launch of a new website dedicated to promoting and explaining the benefits of passive house: **https://passivhaus.etude.uk**

The experienced Cocreate passive house team will also move to Etude. Will South, previously working for both companies, will continue to lead design and certification. Will is one of only four passive house certifiers dedicated to the UK market and has certified close to 100 passive house and Enerphit dwellings over the past six years.

In a statement Will South said: "We are excited to be formalising a long standing relationship with Etude and look forward to bringing expertise honed on passive house buildings to a broader range of projects."

Etude are a London-based team of sustainability engineers specialising in low energy building design and environmental assessments. The company develops sustainable and energy efficient solutions for buildings through all phases of design and construction.

The move will not affect current projects. ■





(above) Will South and his colleagues at CoCreate will be continuing their passive house design and certification services at Etude; current projects include design work at University of Nottingham's Research Acceleration and Demonstration (RAD) building.





Nilan installs popular 'Compact P' at Hampshire apartments

Nilan UK recently completed the installation of its leading Compact P all-in-one heating and ventilation solution to 14 self-contained apartments that are being retrofitted into a derelict former hotel in Farnborough, Hampshire.

With a fabric-first design by leading passive house consultancy Enhabit, the existing building was insulated externally, while the roof was replaced and the internal space totally reconfigured. An extension was constructed using Enhabit's own pre-fabricated timber frame system.

The retrofit was designed in the passive house software PHPP, though it did not seek to meet the standard. The Compact P, which integrates an air-to-air heat pump with heat recovery ventilation, provides space heating, domestic hot water and ventilation to the apartments. The units also feature Nilan CTS 700 heating controllers.

The client on the project is Flying Butler Apartments, who specialise in the rental of high-end serviced apartments.

Meanwhile, Stuart Laughton of Nilan UK told Passive House Plus that the company is also installing 89 Compact P units at the Eco Grove development in East London. Laughton also told Passive House Plus that the company's own low energy offices in Horsham, West Sussex are nearing completion. ■

(above) The old hotel pre-retrofit, and a drawing of the upgraded and extended building's side elevation.



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THE DEVIL is in the details

The use of properly calculated, well executed thermal bridging details can make it much cheaper and easier to achieved good energy ratings and comply with tightening building regulations. But these benefits can only be realised if buildings are designed and constructed in accordance with the details – which requires great care – argues Simon McGuinness.

The Accredited Construction Details (ACDs) were first introduced in the UK in 2007 and as Acceptable Construction Details (ACDs) in Ireland in 2008. They cover some 160 separate details applicable to about 95% of all residential construction and a significant proportion of low-rise non-residential construction.

Many building professionals rely on the ACDs as prima facie evidence of compliance with building regulations. However, they are not without their critics, especially as they have failed to keep pace with developments in overall building performance since their introduction. It is chastening to think that they were considered best practice when first introduced. 10 years later, they are now found only in the worst performing buildings that it is legal to build.

Thankfully, there are several alternatives now available that are significantly better than the official ACDs, but it is important to know when a substitute can be relied on to deliver a certified performance in terms of heat loss (Psi-value) or mould risk (fRsi). Both of these critical performance values are derived from thermal modelling.

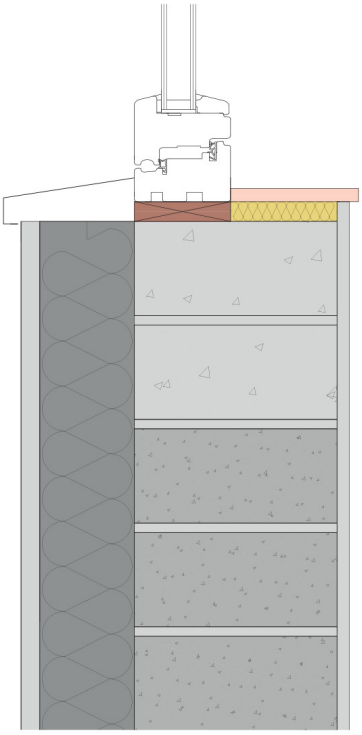
In Ireland, the profession of thermal modelling is regulated by the National Standards Authority of Ireland (NSAI). NSAI-approved thermal modellers are experts whose calculated performance can be relied upon to prove compliance with building regulations for heat transfer and mould risk. The UK has a voluntary scheme and operates its own national convention. Because of this divergence, a detail assessed in the UK may not comply with Irish building regulations whereas all NSAI-approved thermal modeller's junctions are compliant in the UK.

Leading building product manufacturers have produced their own construction details, many certified by NSAI-approved thermal modellers, which form an excellent resource for designers wishing to minimise the cost of construction whilst maximising the performance of completed buildings. In this article, I propose to review one such detail to illustrate the care required when substituting manufacturer's details for officially sanctioned ACDs.

In this field, the Quinn Building Products "Accredited Construction Details" are exemplary. The Quinn sill detail for an externally insulated wall, detail 2.22, for example, assumes the designer will find a way to ensure that an airtight membrane connects the window frame to the internal wet plaster, and that the subsequent fixing of the window board does not damage this membrane. It also requires that a minimum 37.5mm thickness of insulated plasterboard (25mm insulation and 12.5mm plasterboard) is provided to the inside of the window frame beneath the window board and that the insulation layer overlaps the window's bottom frame by at least 15mm. It also requires that the window frame and sill combination must be of a type that allows for a 15mm overlap of insulation on the outside of the frame without creating a pocket to trap rainwater.

If all of those conditions are achieved, then the Quinn ACD 2.22 can deliver a certified Psi-value of 0.012 W/mK and fRsi of 0.95 for a wall with a U-value of 0.15 W/m²K.

In comparison, the official Irish ACD 2.22 (UK MEI-WD-02) will deliver a much more conservative Psi-value of 0.109 W/mK and a fRsi presumed to be at or above 0.75. In other words, the heat transfer through the Irish government's detail is nine times greater than that through the equivalent Quinn sill detail. Such a nine-fold improvement in junction thermal performance is not unusual. Were it to be followed in all details, the allowance for total building heat loss could be reduced by over 40% from default values. This is not an insignificant figure.



An illustration from Quinn's detail 2.22

In a recent survey of 68 experienced Irish building professionals, I found many willing to claim the nine-times-better Psi-value for the Quinn sill detail, but none able to convincingly explain how they were going to get the insulation to cover the window frame by 15mm internally and externally. Many did not even recognise that this was required at all.

That is not how the manufacturer's accredited construction details scheme works: designers must deliver precisely what is specified in the manufacturer's accredited detail to claim the accredited performance values.

Designers do not yet appear to grasp the very limited (almost zero) latitude they have to work within, if they intend to claim the certified performance figures calculated for a manufacturer's accredited detail. Manufacturers offering such details will also need to communicate any conditions attached in language that specifiers can easily understand, possibly using an online-recorded video.

Contractors must also recognise that the superior performance on offer will be unique to the particular manufacturer's products and cannot be claimed if there is any substitution of materials during the procurement or construction phases of a building project.

We all need to learn from this example: manufacturers to explain the latitude possible with their details, specifiers and certifiers to follow the manufacturer's guidance carefully, and contractors to build precisely to the specification and details.

Otherwise, we may as well all step back 10 years in time and build to the official ACDs. ■

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